SCIENTIFIC AMERICAN

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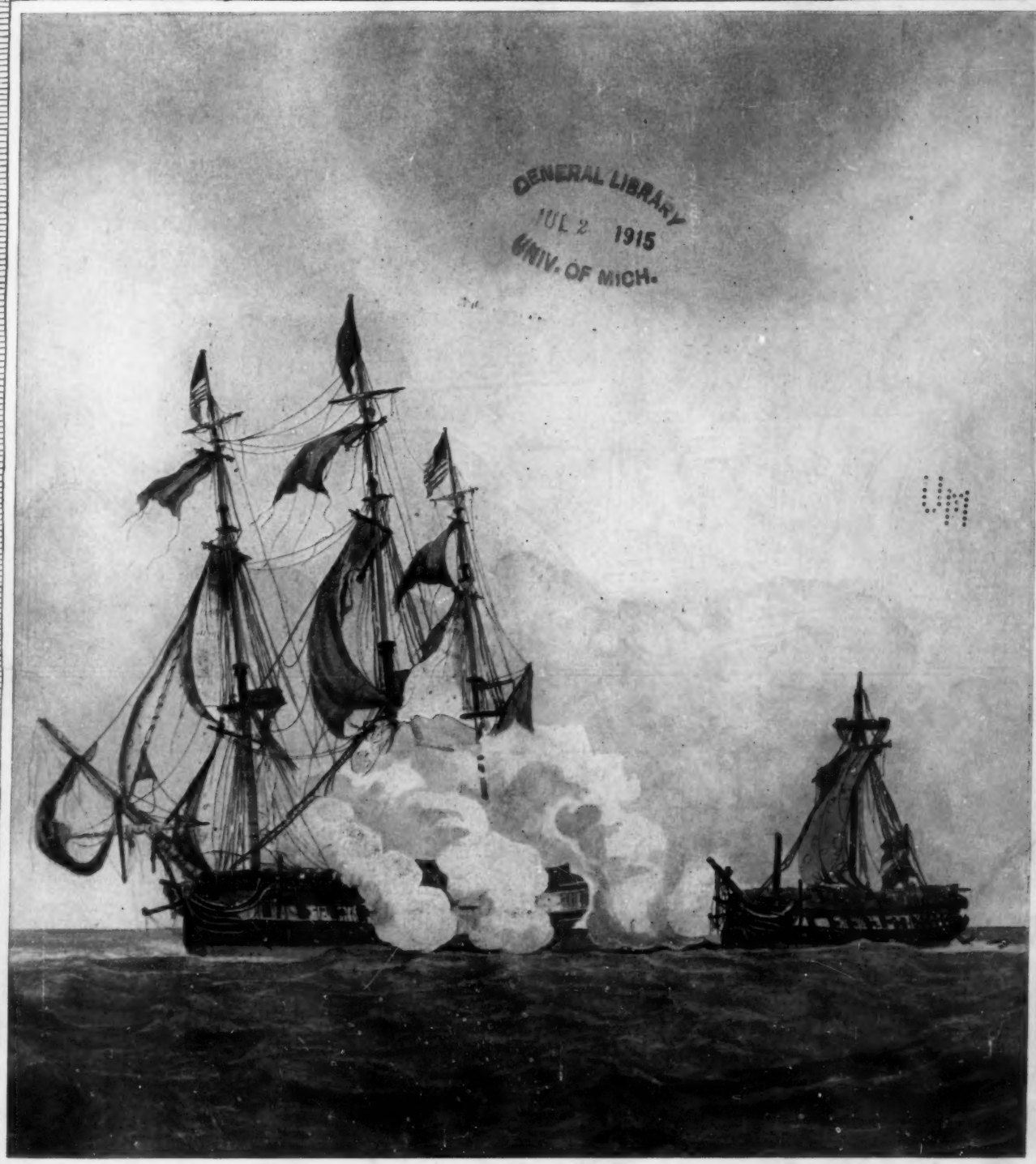

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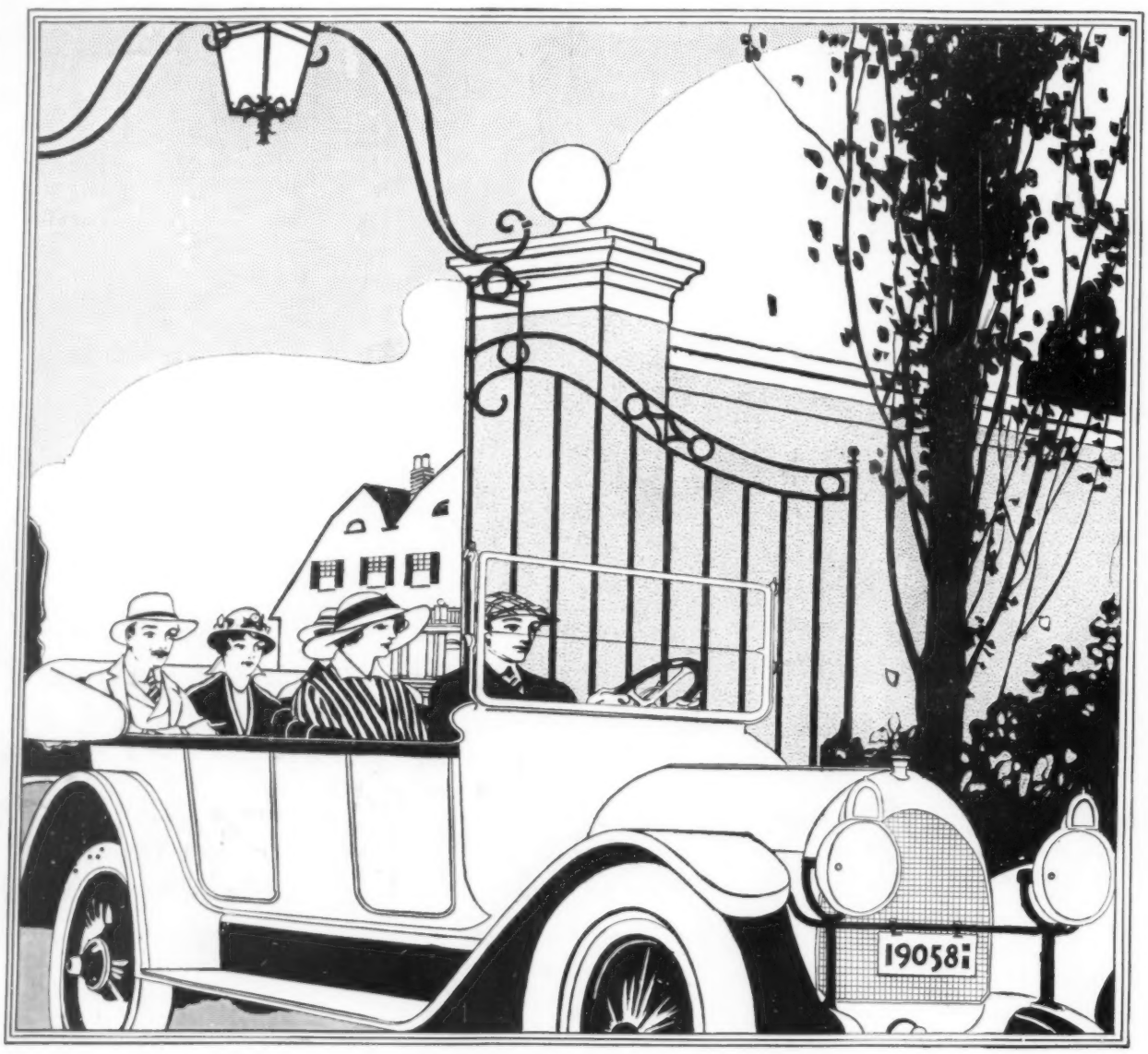

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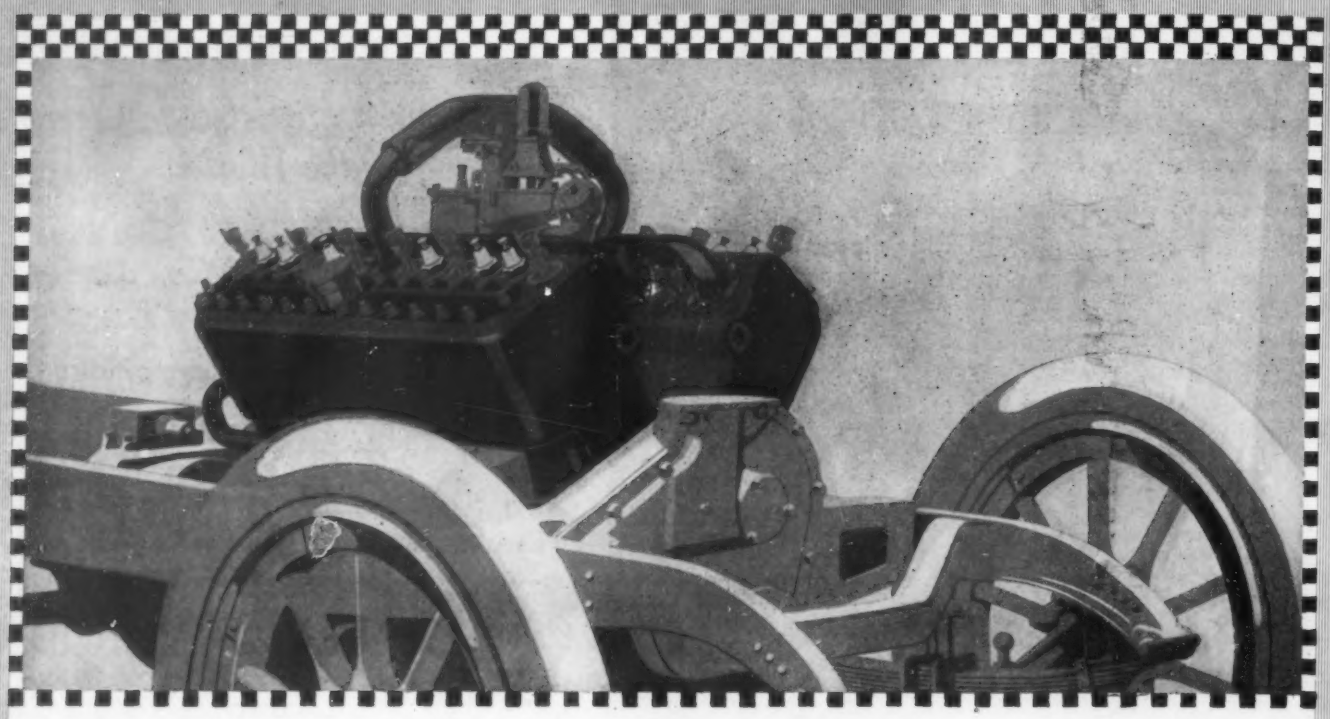

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NEW YORK, JULY 3, 1915

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Training Women To Be Car Conductors

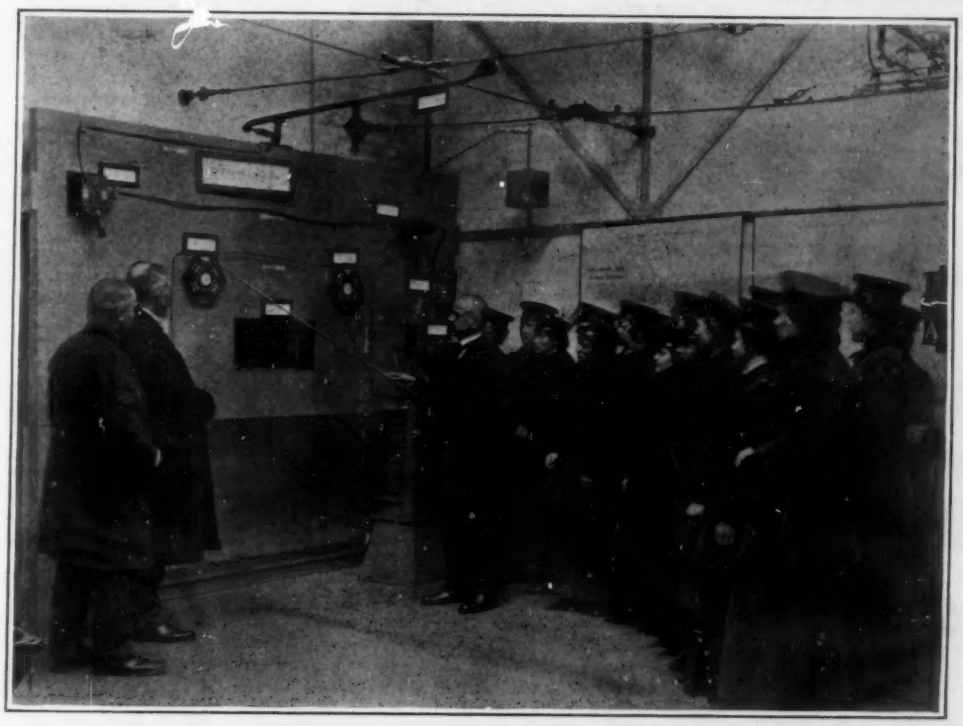
By the Berlin Correspondent of the Scientific American

WOMEN as car conductors have soon become a common feature in Berlin as well as in other German cities, with their strange accouterment—skirt, cap and tunic. Timid at first, they were not long in getting used to the rôle they are called upon to play in war time. In fact, they are now as bold as their male comrades in distributing the tickets, shouting the names of stoppages and answering the inquiries of passengers.

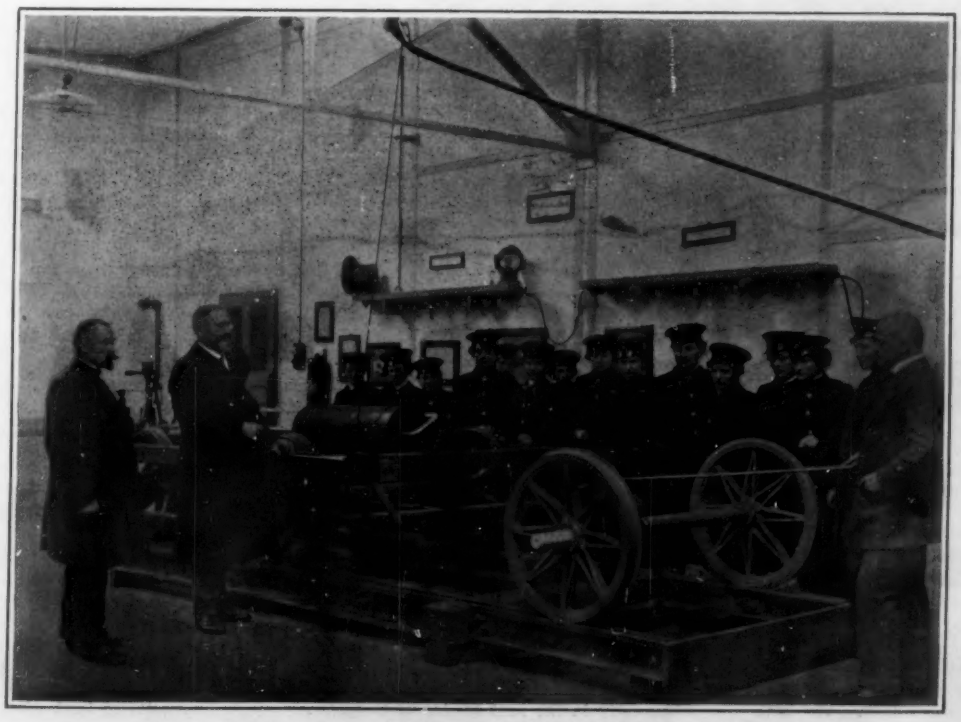
To choose these female guards from among the wives of those called to the colors, was a very wise measure indeed; in fact, it was killing two birds with one stone, as these women had, in any case, to be provided for. Since, however, nothing in Germany is done in a haphazard way, these women had at first to undergo the same theoretical and practical training to which regular tramway guards are subjected.

This training is as comprehensive as could be desired. Those appointed for tramway service receive tuition in the elements of electrical engineering, and, by means of demonstration on dismantled bogeys and the various parts of tramway cars, are taught the very details of their design and handling; experimental lectures, finally, prepare the candidates for the practical training in actual service, which is imparted by an experienced colleague.

For practical reasons and in order to leave them time to attend to their households, these women are only employed for half the day. During the first months, they were only entrusted with service on trailers, but now they can even be seen on motor cars. In spite of all their willingness in doing this somewhat unusual work they will certainly be happy, some day, to resign their temporary charge to their colleagues and husbands.



A lesson in electrical engineering for women who are to become car conductors.



Acquainting the women with the constructional details of a trolley car.

Natural Explosion Phenomena

SOUNDS which resemble cannon firing are produced by natural phenomena in the North Sea and the surrounding plains. Such phenomena have been known for many years, and are of interest at present from the fact that people might often imagine that military operations are going on in these regions. It is at sea that they appear to originate, and they are well known to sailors. The French sailors of the Channel region call them *bombes de mer* or *canons de mer* (sea bombs or cannon), while in Belgium they are known as *mistbommen* (fog sounds) or *onderaardsche geruchte* (underground noises); in Holland, *mistpoeffer* or fog dispeller. Sometimes on shipboard the sailors hear strange detonations which give a painful impression to the ear; the noise does not seem to come from any definite point of the horizon, but seems to emerge as a muffled tone from the depths of the water about the vessel. Nevertheless, it does not give the impression of being produced near at hand, and seems to originate from a far-off place. Another remarkable point is that the zone in which such sounds are produced does not seem to be confined to the sea region, for numerous observers claim to have heard them at a considerable distance inland, for instance in Italy and in some parts of the Alps. The causes of such phenomena are little known. One hypothesis is that of sudden contractions of the earth's surface, which, as is well known, is constantly shrinking. A sudden liberation of tension at any point might thus be the cause. Again, it is not certain whether the effect is of meteorological or marine nature, or whether explosions of gas in mines or elsewhere have to do with the phenomena. It is, however, certain that such noises are frequently heard.

Omens of War

IN a recent number of *L'Astronomie* M. Camille Flammarion publishes an ingenious memoir, illustrated with quaint woodcuts from a sixteenth century work on prodigies, in which he shows that all the celestial and terrestrial omens of war in which our forefathers so firmly believed duly ushered in the great conflict now raging in Europe. These include (1) the total solar eclipse of August 21st, 1914, visible in Europe and Asia; (2) Delavan's naked-eye comet, known as the "war comet," discovered at the close of 1913 and destined to remain visible for the next five years (from which the superstitious might augur seven years of war); (3) the transit of Mercury on November 7th, 1914; (4) the fall of a 35-pound meteorite in England last October; (5) the great Italian earthquake of January 13th, 1915; (6) a "tricolored" star, of which M. Flammarion promises to furnish particulars later, only remarking for the present that it was an optical effect much exaggerated by the popular imagination; and lastly all sorts of remarkable weather, including a wintry day in June of last year, with a minimum temperature of 41 degrees in Paris. It would be too bad to refute this accumulated evidence of the futility of modern science by seeking for previous periods of a year or so in which similar omens were manifested and no war followed.

The Gypsy Moth and Christmas Trees.—Since November, 1912, the Federal Horticultural Board has refused to permit the shipment of Christmas trees and Christmas "greens" from territory infested by gypsy moth, for the reason that it was deemed practically impossible to examine thoroughly the large quantity of such material offered for shipment during the brief period at which it is marketable. The board has, however, now relented so far as to announce that next Christmas it will give a trial to the plan of inspecting and certifying these products and allowing their movement.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Navy for Defense

BY extending our frontiers a thousand miles eastward to Porto Rico in the Atlantic, and five thousand miles westward to the Philippines, the Spanish war broke down forever the traditional isolation of the United States, thrust us boldly into the broad arena of world politics, and imposed upon us international obligations which, in the intervening years, so far from diminishing seem rather to have multiplied in number and broadened in their political significance.

While the Spanish war was being fought and its naval successes achieved, the SCIENTIFIC AMERICAN realized that the great lesson of the supreme value of sea power was certain to sink deeply into the consciousness of the people of the United States and express itself in legislation for the construction of a navy sufficiently powerful to conserve the fruits of that war and enable the United States to maintain the front-rank position into which it was being carried by its uninterrupted successes.

So intelligently did this country interpret the lesson of the controlling influence of sea power that in the brief period of six years Congress, by its liberality in appropriations, had carried the United States Navy up to the position of second in naval strength—a rank to which our numbers, wealth, and far-flung territory entitled us, and from which our Navy should never have been permitted to decline.

In 1904, when the dreadnought made its appearance and all the great powers, realizing the revolutionary character of that ship, began to rebuild their navies along dreadnought lines, we of the United States reversed our policy and began to decelerate construction. This is proved by the fact that whereas from 1898 to 1904 we added to our Navy at the average rate of four armored ships per year, since then, from 1904 to 1913, we have averaged only one and one half new armored ships per year. Hence it is that, reckoned in battleships of the first line, we now stand only in the fourth position, France having recently taken our place as third in rank.

From the very first, the SCIENTIFIC AMERICAN has recognized the supreme value of sea power, and for twenty years past we have sought to interest the public in the United States Navy, particularly as regards its material side—ships, guns, motive power and equipment. Of late we have felt that the time was ripe to broaden the scope of our editorial policy and speak of the relation which the strength of the navy should bear to the population and wealth of this country and to the character of its international policies. We have sought to show not only what should be the characteristics of a navy—its make-up in battleships, cruisers, destroyers—but why, if we are to have a navy at all, it should be of a certain, definite size and strength. We believe that it is better to have no navy at all rather than one which is altogether too weak for its duties. A navy feeble for its duties is a provocation of attack; a navy fully adequate to defend the territory and uphold the principles of the United States is a guarantee of peace—for it discourages even the very thought of attack.

The SCIENTIFIC AMERICAN in all the years of its work for promoting the Navy, has been in favor of a navy purely for the defensive, not for attack. We have always believed, as we do to-day, that a navy of such strength as the General Board recommends, would render an attack from overseas so hazardous, that no foreign power would dare to undertake the task.

As matters stand to-day, our naval and military forces are so far below the standard necessary for security, that the United States may be regarded as a great undefended treasure land; and as such, when the European war is over, it may well engage the covetous attention of one or more of those distracted nations whose coffers will have been drained by the enormous demands of three or four years of the present titantic struggle.

Times of Priority in Germany and France

WHILE some of the European countries at war, notably Germany and France, have issued proclamations or decrees which extend the times of priority and enlarge the opportunities of filing patent applications for inventors during the period of war and for a short period thereafter, these extensions and enlargements, unfortunately, do not apply to the citizens of the United States because of the failure on the part of the United States to enact reciprocity laws. The German proclamations provide that the extensions and enlargements shall apply in favor of subjects of foreign countries when and to the same extent as the priority time limits are prolonged in such countries in favor of German subjects, while the French decrees specify that the benefit of suspension can be claimed only by the persons under jurisdiction of countries which have granted or will grant the same advantages to the French people or people under their protection. It will thus be seen that the failure to effect reciprocity in regard to similar rights to the foreign subjects in this country works a failure to benefit on the part of our people by the provisions abroad.

With us the extension of times of priority involves much more than the mere issuance of a proclamation or a decree, needing for its effect legislative action with all the vicissitudes that such action involves; and while our Patent Office has, through its Commissioner, sought to secure the necessary legislation, this so far has not resulted in any considerable progress, although House Bill No. 20,036 was introduced last session in the House, but failed to pass in the House because of the objections resulting not from any real opposition to the measure, but from considerations of expediency as to the extent to which legislation of this character should be effected. As a matter of fact, the Honorable Commissioner of Patents has done all in his power to aid applications from abroad in securing a filing date and in facilitating the prosecution of such applications in the Patent Office. He has also, by a special practice originated through his kind offices, arranged in numerous cases to delay the issue of the United States patent for a limited period in order to secure the filing of foreign applications in the countries involved in the war. Nevertheless, his action cannot be regarded as responsive to the reciprocity requirements of the proclamations and decrees abroad, and nothing short of legislative action will do this.

It has been urged that reciprocity is a relation or policy which secures special advantages by one side in consideration of corresponding advantages conceded by the other; that in France and Germany there is a condition of war existing which tends to affect the transaction of business with said countries and also may operate to delay official action, while in the United States, fortunately, we are at peace and our business is progressing without delay; that therefore we should not be forced to a condition of equal reciprocity when our internal affairs are so differently circumstanced. But, apparently, it is not realized that the American inventor can suffer many inconveniences and serious losses by reason of the present conditions in Europe. While it is possible to delay the issue of the United States patent after the payment of the final Government fee so that the inventor may have an opportunity to file foreign applications, when, on the other hand, the United States patent has been issued, or in any other case requiring that the patent application be filed abroad under the provisions of the International Convention, a delay in the delivery of the papers or the instructions may be fatal to the case. Furthermore, to keep a patent alive it is necessary to pay taxes and fees within a specified period, and in these days when mails are very slow and uncertain, when cables are frequently lost, when the only means of direct communication with Germany is by wireless telegraphy at considerable expense, the value of a reciprocal agreement between the United States and the warring countries must surely be apparent. It must not be forgotten also that many citizens of the United States have foreign interests which are involved by the war and they are just as much in need of time extensions as foreign inventors. There is no doubt that legislative action is needed, and it is to be hoped that proper measures will be taken early in the next session of Congress.

The Steam Locomotive of To-day

TO those who have in the past attended the annual meetings of the American Railway Master Mechanics' Association, such as that held at Atlantic City, New Jersey, in June, 1915, there is a noticeable change in the character of the delegates. This year the gathering comprised a large proportion of technically educated men, who no longer design and turn out the work of their shops by "rule of thumb" methods; but who rely upon the results of tests and investigations by chemists and metallurgists regularly retained by the testing departments of all important railroads. The past year has shown excellent progress in the improvement of locomotives. Among the many topics assigned for discussion, that of mechanical stokers was prominent, and these devices for supplying sufficient coal in a uniform manner to the gigantic locomotives now in use for heavy freight and passenger service have been made stronger and more reliable. On June 1st, 1915, there were reported to be 895 mechanical stokers in regular use and 164 additional on order. Experience in actual service has shown that a locomotive equipped with a mechanical device of improved type can maintain a steady fire and get "tonnage" trains over the road on schedule, thus making it a more dependable unit of power than one relying solely on the physical endurance of a fireman.

Another device that has been applied in increasing numbers is the superheater, which is installed for the purpose of imparting to the saturated steam an additional amount of heat, thus securing more work from a given volume of steam, and reducing cylinder condensation, a source of considerable loss in locomotive cylinders. By using a superheater, the effective power of the engine is increased without any increase in fuel consumption; and since the difficulties of properly lubricating cylinders and valves when superheated steam is used have been largely overcome, the device has been almost universally applied. Carefully conducted tests have demonstrated that it effects a saving of fuel and water amounting to from 25 to 30 per cent, provided the superheater flues are kept clean and the header connections tight. In this matter, also, attention was called to the fact that prior to the outbreak of the war, some of the railways of Great Britain and Europe were experimenting with the application of superheaters to compound locomotives. As the use of compound locomotives in the United States has been rather limited, and in new construction confined to the Mallet type of engine, the opinion of railway men at Atlantic City was to the effect that operating and traffic conditions on our roads do not warrant the complication and increased maintenance charges that would be involved in compounding in addition to superheating; since the latter makes it possible to realize most of the economies of compounding, without any corresponding losses.

Much closer attention has been shown to the improvement of the draft appliances of locomotives, and many service tests made with new designs of exhaust pipes and nozzles. Some of the latter are made capable of increase or decrease in aperture so as to provide a draft on the fire best suited to the work the engine may be doing. It was agreed that the jet of exhaust steam should not completely fill the stack, but that there should be an annular space around the jet to allow more complete mixture of steam with the gases.

The constantly increasing size of locomotives involves increasing the weight of all moving parts, with the attendant heavy stresses set up not only in the locomotive itself, but in the track structure as well. To reduce these to the lowest practicable point, careful investigations have been carried on to determine the most satisfactory method of counterbalancing the reciprocating parts. It has been determined that to secure the minimum of oscillation and promote smooth riding of the large, heavy engines commonly used, it is necessary to counterbalance about 50 per cent of the reciprocating weights; and that the ratio of reciprocating weights to total weight of the engine should be approximately 1 to 160 or 170. This ratio is attained in many now giving satisfactory service. Special, heat-treated steel is employed for pistons, piston-rods, crossheads, valve gear connections, main rods and hollow crank pins, all for the purpose of reducing weight. Great endeavors are being made to educate firemen in the most effective methods of preventing smoke, especially near cities. As is well known, the city of Chicago has a large force of smoke inspectors whose duty it is to observe, classify and report all black smoke produced. It is said that this service costs the city $39,000 annually; and the railways centering there maintain a similar work, expending $65,000 a year.

Those railroads on which electric motive power has been wholly or partially installed report that employees trained in and accustomed to the operation and maintenance of steam locomotives easily adapt themselves to similar service with electric engines and motor cars. At the present time, portions of fourteen steam railroads have been electrified, comprising 591.3 route miles, or a total of 1,761 miles of track.

Electricity

A Double-filament Gas-filled Lamp has recently been put on the market. The two filaments of the lamp may be operated separately or together, giving the lamp a rating of 200 watts with each filament taking 100 watts. A consumption of 0.6 watt per candlepower is claimed for this lamp and it has a life of 2,000 hours if the filaments are burned separately or 1,000 when they are burned together.

Electric Vehicles for Norway.—Our Vice-Consul at Christiania, Norway, has called attention to the fact that there is a demand for electrically operated motor vehicles of all types in Norway. Being a land of great hydro-electric development, charging stations for the car batteries may be found at frequent intervals and the rates for current are low. Furthermore, the roads are fair and well adapted for electric vehicles.

Gas-filled Lamps for New York Streets.—The gas-filled tungsten lamp is rapidly displacing the flaming arc lamp for the illumination of New York streets. According to the *Electrical World*, in the last six months ten thousand enclosed carbon and flaming arc lamps have been replaced by an equal number of gas-filled tungsten lamps in the 300, 400, 500, 750 and 1,000 watt multiple type and the 400 candlepower series type. About 600 multiple arc lamps in use on the bridges connecting the several boroughs have also been replaced by 300 watt gas-filled tungsten lamps.

Headlight for Electric Flatirons.—A novel electric flatiron has appeared on the market which is provided with a headlight. The latter consists of a small lamp of four candlepower operated at six volts. The beams of this lamp are projected down upon the work directly in front of the point of the iron, and enable the operator to see just what he is doing. The lamp is arranged to burn only when current is flowing through the iron, and for this reason it operates as a signal to show whether the current is turned on or off. Although the lamp is small it is so near the work that it gives plenty of light, and its rays are shielded from the eyes of the operator.

An Electric Hammer.—A portable hammer for use in drilling holes in concrete, brick or stone or for removing scales, paint or rust from tubes or plates, has recently been devised which uses a magnetic clutch to obtain the striking action. The apparatus consists of a hollow sleeve about which is the magnet winding; the ends of the sleeve form the poles of the magnet. A loose plunger operates within the sleeve. The center of the sleeve is largely cut away and the plunger normally occupies a position spanning this center opening. By means of a motor the sleeve is reciprocated, thereby throwing the plunger back and forth by means of the magnetic coupling of the two.

Protecting Workmen in Storage Battery Factories.—A report has just been published by the Bureau of Labor Statistics on the industrial conditions in factories making lead storage batteries, particularly with relation to the danger of lead poisoning. In the construction of lead grids the workman is exposed to the lead dust and lead fumes. In some plants provisions of hoods and exhausts over the kettles, serve to minimize the danger. Another danger lies in the making of the lead oxide when this work is done by hand, but in some factories this work is done by machinery which is inclosed so that there is practically no danger to the operators. Altogether conditions in this country were considered decidedly bad compared to conditions in the same industry in Germany and Great Britain.

Electric Iron Ore Smelting.—According to a recent article in *Engineering* the adoption of electric furnaces in Sweden for the reduction of iron ore is apparently spreading, and the results obtained are encouraging and likely to lead to further developments in this direction. In Norway matters have not progressed quite so smoothly, owing to the different conditions prevailing in the two countries. In Sweden charcoal is used as the means of reduction, but in Norway charcoal becomes too expensive, and unless coke can be used the process cannot be worked with advantage, in spite of Norway's wealth of waterpower. The first attempt with coke at the Hardanger works proved so little encouraging that the whole works eventually stopped, although the ores used were rich in iron. At Tinfos, however, the very opposite experience has been encountered. A regular and remunerative manufacture of electric iron has now been going on for some time, and the production for the present year is estimated at 10,000 tons of electric pig. This satisfactory result is all the more noteworthy inasmuch as the ores used are rather poor so far as their percentage of iron goes, but otherwise what may be called good ore, averaging about 4 per cent. of magnetic iron ore. The four electric furnances used at Tinfos have been worked regularly since the beginning of the present year, one being always kept in reserve. Each furnace produces about 9 tons per day, or 27 tons for the three, making some 10,000 tons per annum. The percentage of pig-iron from the ore varies from 44 to 47 per cent. according to the quality of the ore. The power in the furnace may be as much as 1,200 to 1,400 kilowatts.

Science

Upper-Air Research by the Weather Bureau.—The new aerological station of the Weather Bureau is now fully established at Drexel, Neb., and its staff is busy in the kite field. At the auxiliary station, at Fort Omaha, preparations have been made for a series of observations with *ballons-sondes*, including the installation of a gas plant, at which the hydrogen for the balloons is produced electrolytically. Since the closing of Mount Weather, the administrative office of the Bureau's upper-air work has been in Washington.

A New Branch of the U. S. Department of Agriculture is known as the States Relation Service, and dates from July 1, 1915. Its function is to represent the Secretary of Agriculture in his relations with the state agricultural colleges and experiment stations, and to carry on the work of the department in connection with farmers' co-operative demonstration work, investigations relating to agricultural schools, farmers' institutes, the relative utility and economy of agricultural products used for food, clothing and other purposes in the home, and the maintenance of agricultural experiment stations in Alaska, Hawaii, Porto Rico and Guam. The present Office of Experiment Stations becomes a branch of the new service.

Oil of Chenopodium as a Poison.—There has been much discussion in medical literature as to the occasional poisonous effects of oil of chenopodium, or oil of wormseed, which is used in the treatment of hookworm and of roundworm. Some experiments to determine accurately the resistance of various animals to such effects have recently been reported by Messrs. W. Salant and E. K. Nelson. The toxicity of this substance was found to be distinctly increased in starvation and decreased by feeding a rich carbohydrate diet. Cumulative effects were observed in different animals. Circulation and respiration were depressed. The writers conclude that oil of chenopodium should be given with great care, as it is poisonous even in small doses.

Revegetation of Taal Volcano.—The great eruptions of January, 1911, destroyed practically the whole plant cover of this low volcano, which lies in the middle of Lake Bombon, Luzon. As residence on the island has since been prohibited by the authorities, the process of revegetation has been controlled by natural agencies alone, and a study of it presents the same interest as that of the like process on Krakatoa, concerning which so much has been written. According to the investigations of Mr. F. C. Gates, by April, 1914, 179 species of vascular plants were growing on the island, 138 being dicotyledons. Ferns and their allies, mosses, lichens and algæ were all poorly represented. Water-borne plants appeared first, fringing the shore; then grasses, of which the seeds were borne by the wind; and when these had attracted bird visitors, the seeds of bushes, low trees and climbing plants were imported.

The Chinese Monuments Society.—The recent activities of this society are reviewed in the *Bulletin* of the American Geographical Society, from which journal we learn that the sum of $100,000 of the Boxer Indemnity remitted to China by the United States is to be used in preparing museum quarters at Peking where national antiquities will be collected for preservation and study. The society was founded in 1908 and now has members in all parts of the world. Its object is to protect China's antiquities and cultural objects, especially from occidental vandalism. This movement is supported by the Smithsonian Institution and the American Archæological Institute, and last year more than fifty American universities, museums and other institutions joined in a memorial to the President of China, urging him to further the good work to which the society is dedicated. Any interested person may become a member of the society by sending $2 (gold) to Frederick McCormick, Esq., secretary, care of International Bank, Peking.

Rain from a Clear Sky.—In English dictionaries we find the word *serein* defined as a fine rain which sometimes falls from a clear sky shortly after sunset. The word is French, but has become the international designation in meteorological works for this alleged phenomenon, which is always described as quite rare. Has the phenomenon a real existence? The fact that a stereotyped description of it has been passed on from one meteorological writer to another since the latter part of the 18th century is by no means conclusive evidence on this point, for science has perpetuated many myths by the process of reiteration. Prof. Gustav Hellmann, in a recent publication of the Prussian Meteorological Institute, sees in the conception of the *serein* merely the survival of the old-fashioned belief that evening dew falls from the (clear) sky, and he finds that the *serein* of early French writers was identical with that "evening dampness" which was supposed to be injurious to human health. It still remains possible that rain may sometimes fall from a clear sky, though this is not likely to be a phenomenon peculiar to the early evening. Some cases can be explained as due to the oblique falling of raindrops, carried horizontally by the wind, when the clouds from which they came have passed away.

Inventions

Airship with Sectional Pontoons.—John W. Boughton of Philadelphia, assignor to the Boughton Flying Machine Company, has patented No. 1,138,724, an airship which is provided with supporting pontoons arranged lengthwise of the ship and composed of hollow separate or sectional caissons, which contain air or gas to impart buoyancy and should one leak the others will remain intact.

Stove on Automobile Step.—In patent No. 1,140,055, Emanuel S. Mumma of Rock Hill, Pa., provides on an automobile running board a gasoline stove which is suitably connected to receive its supply from the fuel tank of the machine and can be utilized by tourists or campers, being, when not in use, covered by an asbestos lid, which is hinged so it can be readily thrown back out of the way.

Converts Hand Bag Into a Seat.—With a woman's ingenuity, Katherine V. Minehart of Philadelphia has patented, No. 1,140,997, a hand bag composed of two similar sections hinged together at one end to form the bottom of the bag and connected at their edges by the flexible sides of the bag of such size as to permit the bag to be opened so that one of its similar sections may serve as a seat and the other as a back rest for a person sitting on the seat when the latter is flat on the ground or other support.

Regulates Speed of Automobile.—In patent No. 1,142,099, Mille Reese Hutchison of Bay Shore, New York, seeks to avoid destructive wear and tear by an ignorant driver of an automobile by providing means for controlling and limiting the speed of road travel of the machine by controlling or limiting the motor speed by and in accordance with the road speed, in doing which he provides an automatic throttling mechanism, which will throttle the motor when the vehicle travels faster than the desired rate.

Cigar Bunchers.—That Oscar Hammerstein of New York city has not lost his interest in cigar manufacture is evidenced by patent issued to him recently, No. 1,142,164, for a process of making cigar bunchers, wherein a number of filler leaves are placed, one upon the other, with the center portion of each leaf practically in alinement and the leaves are cut transversely into three parts, on intermediate sections and end sections, the end sections being then placed upon the intermediate sections and the combined sections being rolled up to form the buncher.

Desired Improvement in Duplicating Machines.—A school official having occasion to use an apparatus for making duplicate copies, tells the writer that he thinks an improvement might be made in the way of a stencil to be operated by a typewriting machine which could be operated dry, thus avoiding the gumming up of the typewriting machine. It appears that the stencils now generally used are wet previous to operating upon them by the typewriting machine, and the desire is to produce some stencil that can be as efficiently operated in a dry state.

Delays Issue of Official Gazette.—For probably the first time in the history of the Patent Office, the issues of the *Official Gazette*, that useful chronicler of inventive effort, are being delayed for lack of funds. Strangely, too, this does not result from a lack of activity in the issue of patents, but because the regular appropriation of $440,000 for printing specifications in the *Official Gazette* and supplemental appropriation of $125,000 have been nearly exhausted as a result of the large issues of patents during this year, and the Commissioner of Patents has announced that the issues of the *Gazette* for June 15th, 22nd and 29th will not issue on those dates, but these issues will be sent out as early in July as the publication thereof can be brought about and owing to the resulting congestion, there probably will be some delay in the issue of the *Gazette* for July until conditions in the office of the Public Printer become normal. There will, however, be no delay in the issue of patents, designs and trade-marks.

Facilities in German Patent Matters.—The Ambassador to Germany has transmitted two proclamations promulgated by the German Government under date of May 7th, 1915, one of which extends the priority time limits provided in Article 4 of the revised Paris Convention for the Protection of Industrial property of June 2nd, 1911, to the expiration of six months after the termination of the state of war, but at the latest to June 30th, 1916, provided they did not run out prior to July 31st, 1914, the provisions applying to subjects of foreign countries when and to the same extent as the priority time limits are prolonged in such countries in favor of German subjects. The other proclamation provides that the time limits set in patent, model and trademark matters for applicants residing in foreign countries have been extended by the competent authorities of the Patent Office as follows, wherever no special action has been taken in individual cases: (1) For applicants residing in Europe, for 3 months; (2) for applicants residing in the United States of America, for 4 months; (3) for applicants residing in other non-European countries, for 6 months.

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Outpost connected by telephone with the field artillery.

French soldiers throwing hand grenades into the German trenches.

Trench Warfare

Ten Hours of Trench Digging for Ten Minutes of Rifle Fire

By Capt. W. D. A. Anderson, Corps of Engineers, U. S. Army

THE wonderful accuracy and power of modern artillery have driven armies underground as the only salvation from annihilation. At the same time the enormous numbers of men engaged extend the flanks so far that turning movements are often impossible and battles must be decided by frontal operations.

In the wars up to the Russo-Japanese war in 1904-1905 the campaigns consisted largely in maneuvering the armies so as to threaten the enemy's flank. Now the important advantages are gained by maneuvering the heavy artillery so as to bring a preponderance of fire to bear upon a definite length of the enemy's front.

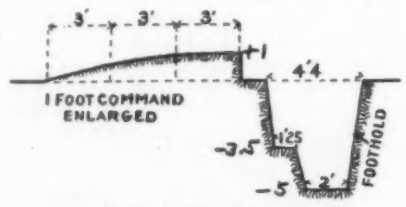
The shattering power of high explosive shells can reduce to a rubble mound any structure on which they are brought to bear. Consequently the military engineer recognizes this physical limitation of the defense and adjusts his structures by utilizing mounds of sand or earth for parapets. The energy of the shell is largely used up in raising a cloud of earth, most of which falls back in place.

After a bombardment a line of field fortifications looks more like a spoil bank than a defensive work, but its resisting power may be little diminished. The very irregularity aids in rendering the exact trench line less conspicuous.

Prolonged bombardment will in time destroy any trench, but an active defense can offset this by continuous extension and reconstruction of the lines of trenches. While the artillery of the defense counter-batters the attacking artillery, the soldiers of the line wield their picks and shovels to repair the trenches. Instead of the dash and glory of historical warfare, the soldier of to-day has the prosaic task of devoting over ten hours to trench work for every ten minutes spent in firing his rifle.

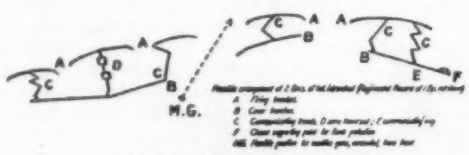
The principle of trench warfare consists in providing a number of lines of trenches so that if one is captured the next succeeding line can be held. By delaying the enemy at each successive trench time is gained to bring up reinforcements of men and artillery.

The artillery is depended upon for bombardment and for action against groups. Its long range and accuracy permit the batteries to be placed on the reverse slopes of hills from one to six miles in rear of the advanced



Simple form of firing trench.

lines. Here the guns are safe from observation except by aeroplane scouts, and the gun crews are further protected by parapets. So important is concealment



Various types of trenches.

that even in these protected locations the guns are screened by being placed in woods or orchards or by being covered with branches or with hay.

Concealed Artillery Emplacement.

The man at the gun does not see his target. The observation of the objective of fire and of the effect of shots is carried out at a distant point. Information is telephoned in to the battery and calculation is made of the change in azimuth or elevation needed to correct the landing point of the shots. In this way the objective of the gunfire may be changed from point to point as the progress of the action dictates.

The close contact is maintained by the infantry, who depend upon the firing trenches for their effective work. These are deep narrow trenches with a steep revetted bank on the side toward the enemy. A bench is provided against this bank, or interior slope, so that men standing on the firing bench will be conveniently placed for firing over the parapet. A large stock of cartridges is placed on a bench cut in the parapet so that each man may continue his firing without changing position.

Firing Trench, Simple Type.

To give the man in the firing trench a still better chance to stop an attacking force the ground in front is covered with obstacles that will delay the enemy without affording any protection. Any device is used, but the best of all is barbed wire. It cannot be shot away, even if cut it coils up and entangles the feet. As chance offers, barbed wire is crisscrossed between the posts until a formidable entanglement is obtained.

The trench guard must be close at hand, ready to man the firing trenches on a moment's notice. At the same time they cannot stay in the trenches during bombardment as the protection is so slight that the losses would be excessive. This object is secured by having a cover trench close by, a deep narrow trench from which entrance is obtained into underground shelters.

Where a ravine or reverse hill slope is near enough, the cover trench consists merely of the line of entrances into the bombproofs. In these cellars, or bombproofs, the trench guard sleep, eat, and live during their 48-hour tour at the front. New detachments are then brought up to the front line, while the old guard goes back to the reserve for four days' rest.

Numerous passages are provided for the quick rush

Wire netting as a shelter from hand grenades.

An observation station overlooking the sand dunes.

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A British firing trench, showing traverses.

Trench, with traverses, bordering a stream.

of the soldiers from the cover trenches to the firing trenches. If these were direct, the enemy's shrapnel might rake them and prevent the arrival of reinforcements. To prevent this the communicating trenches twist and turn so that every part of the trench is protected by the turn next ahead.

Not only must these zigzag communicating trenches be dug between the advanced trenches, but even far to the rear. Modern artillery can in less than one minute get the range and hit an exposed target two miles away. Communicating trenches must be provided from the first line all the way back until the hills or folds in the ground will protect the rest of the route. Thus, for a zone of approximately a mile along the battle front, every move must be made in deep trenches.

The firing trenches at the front are not necessarily continuous. They are required only to oppose an advance of the enemy along gulleys or valleys or through woods. The open spaces are fully covered by artillery and machine-gun fire. The connecting trenches, however, fill in the gaps so as to make a practically continuous line.

Everywhere provision is made for protection against enfilading fire. The communicating trenches are zigzagged, or are defiladed by roofing them over with logs and mounds of earth at short intervals. The firing trenches are also defiladed by offsets, or traverses, at intervals of about 12 yards. The traverses furnish raised mounds, or parapets, extending across the line of the trench and protect the soldiers from flank attack.

The above description covers only one firing line and its appurtenances. Reserve lines similar to these are dug in rear, at least two of them. As the sapping operations gain ground toward the enemy, new lines are constructed every hundred yards or so. If the enemy's lines are captured they are reconstructed for the use of the captors. At times these operations may lead to an army's having ten or more parallel lines of trenches along a short length of front.

After the simple lines of trenches are completed the troops are kept at work improving them. Deeper bomb-proof shelters are constructed and concrete is made use of for supporting and retaining walls. To take care of the ground water a complete drainage system is dug out with ditches or drain pipes leading to a natural outlet or to a sump from which the water is pumped away. After a few weeks occupation the line of entrenchments becomes a semi-permanent fortification, with underground chambers and communicating trenches.

Laying a water-supply pipe to the trenches.

Defensive Trench Warfare.

In defensive tactics the trenches serve to strengthen a line so that the forces holding it can be reduced to a minimum. The troops thus released can then be concentrated at another point where an attack is to be made. The line is held by maintaining a trench guard in the cover trenches of the advanced line. A few sentinels are placed in the firing trenches, but the main dependence for detecting an advance of the enemy's forces is placed on the concealed observation stations and on the aero service.

The trench guard furnish only a delaying resistance while the forces in the rear are taking their positions. The main line of resistance is far enough back of the first line to give plenty of time for the warning and forwarding of reinforcements. The principal bodies of troops are kept back where they will not be subjected to bombardment.

The front line is then held by a line of sentinels, who are reinforced by the trench guard from the cover trenches. About 300 yards to the rear are supporting bodies who either reinforce the advance trench defenders, or else hold a line to which the trench guard falls back. Still farther to the rear, in a central sheltered position, is maintained a large reserve which is charged with the duty of maintaining the fighting strength of a definite length of front, which for a European regiment of 3,000 men would be about half a mile.

This organization provides successive increases in the strength of the resistance to attack. The main object is to stop the enemy if possible or else to delay his forces until reinforcements can be brought up. Even where the attack is strong enough to break through, the above tactics delay operations so much that troops can be rushed in from both sides to form a new line in rear of the weakened point.

Tactics of the Aggressor.

The aggressor in trench warfare has to use similar tactics for his infantry and must above all have a pre-

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A British concealed artillery emplacement.

Special type of gun used by the French in their trenches.

ponderance of artillery. Without the latter an advance would result only in slaughter.

The advance is prepared by placing the batteries of artillery in concealed positions from which their fire can be concentrated on the vicinity of the point selected for attack. Information is carefully gathered as to the location of the enemy's batteries and lines of trenches. At a prearranged signal the trenches and the ground in rear are bombarded with high explosive shells in order to drive out the defenders. Probable artillery locations and communicating trenches are raked with shrapnel fire. Close watch is kept of the effect of the fire and of any movements of the enemy that can by any possibility be detected.

The troops for the assault are meanwhile gathered in the most advanced trenches. When the enemy's infantry and artillery seem to be driven to cover the signal for the advance is given. The attackers scramble up out of their trenches. Selected groups rush forward to cut the enemy's wire entanglements or to blow up the obstacles in front of his parapet. The rest follow close behind with bayonets fixed for the hand to hand struggle with the enemy's men that still remain in the conflict.

All the time the supporting artillery must keep up its fire. It must quickly locate and silence any hostile guns that open fire on the attacking troops. It must also cover with its fire all the ground in advance of its own troops so as to prevent the enemy from moving up reinforcements. The expenditure of shells and shrapnel thus mounts up to enormous figures.

So accurate is the ballistic control that artillery fire is kept up over the heads of the attacking troops and the shell and shrapnel fuses can be cut to burst only 400 yards beyond them. This bombardment of the ground close in front keeps the enemy's riflemen under cover till the last minute and saves many lives for the attackers. Artillery thus becomes the indispensable arm of trench warfare. The artillery gains the dominance, while the infantry clinches the advantage.

The above describes one incident of the fighting. It requires careful planning and preparation to assemble the troops and to provide the immense amount of munitions needed without betraying the project. From beginning to end the forces engaged must work together with perfect discipline. The final assault must nearly always be made at night to reduce the exposure and the consequent losses. The cost is great if successful, but is still greater if repulsed.

Every trench gained requires these tactics. Sometimes the assault carries several lines of trenches, but generally the defense stiffens so that only the advanced line is captured. The advantage must be gained one step at a time, each the preparation for the next. Only by a long series of small gains, each tending toward a general end, can an advance be gained that will have immediate strategic results.

The Zeppelin

VERY precise information is at hand regarding the useful load of the 1913 class of Zeppelins. The log-book of the "Z-4" (the one that landed involuntarily in France) showed upon examination that this ship, which displaced only 688,000 cubic feet, had a carrying capacity of 10,600 pounds, made up as follows:

Crew (twelve men)	1,920 pounds
Fuel (for 12 hours)	3,780 pounds
Ballast	3,500 pounds
Armament (replaced by ballast)	1,400 pounds
Total	10,600 pounds

A fuel capacity of twelve hours at thirty-five knots gives a cruising radius of 420 nautical miles. London being 300 miles from the nearest Zeppelin base (Cologne) the projected aerial invasion would be a thing utterly impossible with this class of airship. In order to increase the cruising radius of the Zeppelin, the 1914 class was given a greater displacement, which was obtained by lengthening the 1913 type through the addition of two balloon sections whose lift increased the useful carrying capacity by 3,400 pounds. This was utilized as follows:

Crew (four more men).....	640 pounds
Fuel (8 more hours)	2,520 pounds
Ballast or explosives	240 pounds
Total	3,400 pounds

The increase of the crew became necessary for two reasons; firstly, because all the preceding Zeppelins were undermanned in peace time, there being no provision made for the men required to operate the guns, the bombs and the searchlights; secondly, owing to the difficulty of handling a larger sized airship on a longer cruise.

The above figures give the 1914 military class a cruising radius of 700 miles, i. e., a distance just sufficient for a trip over land and sea from Cologne to London and back.*

* Evidently fuel might now be replenished at the nearest point of the Belgian coast line.

Little official information is at hand about the new naval type of Zeppelin, except that it displaces 950,000 cubic feet and carries a crew of at least 28 men, while a fourth motor has been added to its power plant. Let us now figure out how the additional weight is distributed.

We know that the useful load of a Zeppelin amounts to about one fourth of its total lift; 138,000 more cubic feet should, therefore, give an additional useful load of about 5,500 pounds, or else for a 950,000 cubic foot ship a useful load of 19,600 pounds. If we assume that the new type's cruising radius has been increased only through the greater speed attained by an additional motor (50 knots instead of 45) and amounts to 800 miles, no additional fuel tanks having been fitted (except for the fourth motor) we get the following figures:

Crew (28 men)	4,480 pounds
Fuel (20 hours)	8,400 pounds
Total	12,880 pounds

which being subtracted from the total useful load, viz., 19,600 pounds, would leave available a ballast of 5,160 pounds. Assuming the ship requires the same amount of dead ballast for its navigation as the military type, viz., 3,500 pounds (for the total lift of a Zeppelin increases more rapidly than its weight) the load available for armament and explosives would amount to 1,660 pounds, or practically the same as that carried by the 1914 army type.

Evidently part of the dead ballast may be replaced by explosives; but this arrangement entails considerable risk, for should a Zeppelin be forced by atmospheric conditions to lighten itself suddenly in order to ascend to a higher level and its ballast consist only of explosives, the latter may cause destruction indiscriminately among friend and foe.†

That the most modern Zeppelin does not carry more than 2,000 pounds of explosives is evidenced by the fact that the heaviest bomb dropped by one of these ships (dropped at Yarmouth) weighed about 100 pounds, and that nowhere twenty of these bombs were dropped by one airship. In fact, the heaviest bombardment by Zeppelins was that of Paris on March 21st, and the two ships that carried it out dropped altogether about fifty bombs, out of which only about half a dozen were of the heaviest type, while the remainder was made up of incendiary bombs weighing about 30 pounds.

War correspondents of imaginative mind have told the world more than once that the Zeppelin factories were busily building super-dreadnoughts-of-the-air of 1,400 feet length which launch torpedoes weighing something like 500 pounds, and can therefore destroy a "Queen Elizabeth" with the greatest ease.

Serious-minded people should not attach too much credence to such fantastic reports. The Germans are too practical a people to indulge in such foolish ideas. There are some very good reasons, too, that it should be so.

First, it would take several years to develop an airship thrice the size of the present-day Zeppelins to perfection; secondly, even if such a ship was actually built there would be no place to house it, for the largest German dirigible shed, that of Leipzig, is only 630 feet long; thus, in order to house those phantasmagoric super-Zeppelins, all the sheds would have to be entirely rebuilt, and not only lengthened, because the diameter of airships obviously increases with the length.

The German engineers would never take such a plunge into the unknown for the realization of a machine that can be perfected but step by step, through small increases in size, in motive power, in cruising radius, each improvement being applied at a time to every new unit. In fifteen years' time Zeppelins have just doubled in size; can any fair-minded man suppose that amid all the concern of the war the Germans have found the miraculous *moyen* to treble in six months' time the size and power of the latest Zeppelin that was launched just when the war broke out and was spoken of by the same esteemed *confrères* as the "latest word in fighting monsters of the air"?

The Zeppelin Fleet.

After this brief digression we shall examine how many airships of the Zeppelin pattern there were in commission at the outbreak of the war and how many have been turned out since.

On July 31st, 1914, there were exactly *eleven* Zeppelins available for warfare. Seven of them (named "Z-2" to "Z-8") belong to the German army; two were in commission in the navy (the new "L-3," just completed, and the "L-5," which had been the "Sachsen" of the Aerial Transit Company and was purchased by the navy in order to replace the ill-fated "L-2" that was lost accidentally); there were also available two passenger airships, called the "Hansa" and the "Viktoria-Luise." Out of these eleven ships four were practically obsolete ("Z-2," "Z-3," "Hansa" and "Viktoria-Luise"), and of the remainder four had been launched or remodeled in 1913 ("Z-4," "Z-5," "Z-6," and "L-5"), and three were of the latest type ("Z-7," "Z-8," and "L-3").

† Bombs were dropped as ballast in England without fuses and did not explode. Count Zeppelin states this fact personally in proof of the fact that no bomb was aimed at civilians.

Although all of Germany's military and naval activity is shrouded by a seemingly impenetrable veil, the Friedrichshafen factory on Lake Constance is credited with having completed up to the month of April, 1915, one airship every three weeks; while the new Potsdam factory is supposed to turn out one airship every four or five weeks. Since then the working capacity of the Friedrichshafen factory has been increased to such extent that now one airship is reported to leave the yards every fortnight. This output would give April 1st, 1915, a total of seventeen Zeppelins launched after the outbreak of the great war, which added to the ante-bellum status of eleven ships, would give a gross total of twenty-eight units.

Official information from Germany admits the loss of nine Zeppelins, but there is well substantiated reason to believe that twelve airships of this pattern have met their doom during the war. The number of Zeppelins remaining in commission on April 1st should, therefore, not exceed sixteen, no allowance being made in this figure for ships having been temporarily disabled.

According to a statement given out by Count Zeppelin's secretary, "fifteen airships of a greatly perfected type, each being armored and capable of carrying two tons (4,000 pounds) of explosive, are to be delivered by July 15th. These ships will be fitted with a system for increasing the ascending speed, which will enable them to attain an altitude two fifths better than the best hitherto possible."

While the actual efficiency of this new type still remains a thing hypothetic, it is interesting to note the amount of damage effected by Zeppelins during the first six months of the war, for which official figures are available: from August 1st, 1914, up to January 31st, 1915, fourteen Zeppelin raids have taken place, in the course of which one hundred and sixty persons were killed and some hundred buildings destroyed. This destructive activity was purchased at the price of half a dozen airships annihilated and sixty men of their crews taken prisoners and thirty killed. On the other hand, in spite of fifty bombs dropped in the course of the Zeppelin raid upon Paris, only one person was seriously injured and none killed, while seven persons were slightly injured. The damage done to buildings was in no proportion to the amount of explosives discharged. Thus, it seems that the Zeppelin's military efficiency is somewhat far from the altogether too optimistic expectations some people have attached to this form of aircraft regarding its destructive and demoralizing power.

Inorganic Fodder

By the Berlin Correspondent of the Scientific American

IN the economic struggle fought by Germany simultaneously with war proper, she calls in the aid of her remarkably organized science. We have referred, in these columns, to the way her grain supplies are "stretched"; we have also mentioned an attempt to derive from straw and hay all the nourishing matter contained therein. There is now a new development in the same line. In view of the imminent scarceness of nourishing fodder of organic origin—linseed-cakes, barley, etc.—the resources of the chemical laboratory are to be drawn upon, the mineral kingdom supplying what the vegetable kingdom is unable to yield.

Germany is known to possess abundant supplies of potatoes, beet-roots, turnips, that is, materials holding carbohydrates. Albuminous fodder, on the other hand, was available only in limited quantities, and had, for the most part, to be imported from Russia. Now, an invention recently made at the Institute of Fermentation Industries, Berlin, will, it seems, allow a nourishing yeast containing more than 50 per cent of albumen to be prepared from sugar and ammonium sulphate. Sugar is, to this effect, bound to an inorganic base; in order to supply the albumen, so far wanting, the sugar is "fertilized" with ammonia, potash and magnesia, in the form of their salts, after which some yeast is introduced and a strong air current applied. The yeast then absorbs the sugar and the "fertilizer," thus resulting in the formation of a highly albuminous yeast. This is how inorganic nitrogen supplies immediately a material containing albumen in a high concentration (50 per cent).

The process above outlined, of course, can be used only in such countries as are amply provided with sugar and ammonia. Germany, as is well known, raises much beet sugar, while Dr. Haber's synthetic process enables ammonia in any amounts whatever to be prepared from nitrogen and hydrogen.

The dry yeast obtained according to the above process constitutes an excellent nourishing fodder for cattle, but in the first place for horses. It is now prepared in existing press-yeast factories, but will shortly be manufactured in large works especially erected for the purpose.

The new invention would seem to be of an importance

even exceeding present contingencies. It is, in fact, expected to utilize it even in times of peace, inorganic fodder being substituted for Russian barley, to an extent depending on the actual price of the latter.

Cipher Codes and Their Uses

By E. C. Edwards

THE methods followed by spies in Europe have been the subject of several articles recently, which have created an interest in the various kinds of secret codes. Poe said and it is believed proved that he could translate a real message sent in any cipher. However, the

A B C D E F G H I J K LM N O P Q R S T U V W X Y Z
B C D E F G H I J K L M N O P Q R S T U V W X Y Z A
C D E F G H I J K L M N O P Q R S T U V W X Y Z A B
D E F G H I J K L M N O P Q R S T U V W X Y Z A B C
E F G H I J K L M N O P Q R S T U V W X Y Z A B C D
F G H I J K L M N O P Q R S T U V W X Y Z A B C D E
G H I J K L M N O P Q R S T U V W X Y Z A B C D E F
H I J K L M N O P Q R S T U V W X Y Z A B C D E F G
I J K L M N O P Q R S T U V W X Y Z A B C D E F G H
J K L M N O P Q R S T U V W X Y Z A B C D E F G H I
K L M N O P Q R S T U V W X Y Z A B C D E F G H I J
L M N O P Q R S T U V W X Y Z A B C D E F G H I J K
M N O P Q R S T U V W X Y Z A B C D E F G H I J K L
N O P Q R S T U V W X Y Z A B C D E F G H I J K L M
O P Q R S T U V W X Y Z A B C D E F G H I J K L M N
P Q R S T U V W X Y Z A B C D E F G H I J K L M N O
Q R S T U V W X Y Z A B C D E F G H I J K L M N O P
R S T U V W X Y Z A B C D E F G H I J K L M N O P Q
S T U V W X Y Z A B C D E F G H I J K L M N O P Q R
T U V W X Y Z A B C D E F G H I J K L M N O P Q R S
U V W X Y Z A B C D E F G H I J K L M N O P Q R S T
V W X Y Z A B C D E F G H I J K L M N O P Q R S T U
W X Y Z A B C D E F G H I J K L M N O P Q R S T U V
X Y Z A B C D E F G H I J K L M N O P Q R S T U V W
Y Z A B C D E F G H I J K L M N O P Q R S T U V W X
Z A B C D E F G H I J K L M N O P Q R S T U V W X Y

method he used, as described in "The Gold Bug," and the same method used later by Conan Doyle, in the "Adventure of the Dancing Men," would fail to translate the cipher described herein, as will be shown.

This cipher is very simple, consisting of a non-secret diagram and a key word. The diagram, while necessary in the translation, is absolutely valueless without the key word, which may be any word or group of letters desired, making the chance of stumbling on it by accident one in several hundred million.

The cipher is used as follows: Suppose we wish to send the message, "The Germans are advancing on Paris," and our key word is "black." The message is written out and then the word "black" is written over the letters of the message in succession as follows:

BLA CKBLACK BLA CKBLACKBL AC KBLAC
THE GERMANS ARE ADVANCING ON PARIS.

Taking the first letter, "T," we turn to our diagram and look in the horizontal row beginning with "T," for the letter we have written above it, that is, "B." We then take the top letter in the same column as this "B," namely, "I," as the first letter of our code message. We then look for "L" in the "H" row and find that the top letter of that column is "E." Similarly we find the third letter to be "W" and the final cipher is as follows:

IEWWGKZAPSBUWCHGLNACOFMPVBUSK

In translating, exactly the same method is used. The person receiving the message writes the key word in succession over the letters and proceeds the same as if he were making up a message.

BLACKBLACKBLACKBLACKBLACKBLAC
IEWWGKZAPSBUWCHGLNACOFMPVBUSK

Thus, he takes his diagram, looks for "B" in the "I" row, and finds the top letter of the column to be "T." The second letter, found in the same way, proves to be "H," the third "E," and so on until the entire message is translated.

Poe's method of translating a long cipher was to assume the symbol appearing the greatest number of times to be "E," as that letter occurs most frequently in ordinary usage. This method would fail in this case, for the same symbol in the cipher might mean several entirely different letters in the original. Thus "W" in this message stands for both "E" and "G" and in a longer one would probably have several other meanings.

This code seems so simple and at the same time so impossible of translation, that it is surprising that secret messages should ever be read by anyone not supposed to know their contents. The key word can be changed in a second and the diagram can be prepared at any time. There is absolutely nothing connected with it to fall in the hands of an enemy, for the key word would naturally be remembered and would not have to be written down.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Gas Inertia Result

To the Editor of the SCIENTIFIC AMERICAN:

A recent experiment brought out an unexpected result that may interest your readers, particularly those that are students of the gas engine. For a number of years I have been using the energy remaining in the exhaust gases to recharge the engine cylinder, thus saving the negative work commonly expended to accomplish this result. It is well known that there is considerable energy still remaining in the gases that are released at the close of the working stroke. It is this that makes the noise and requires a muffler. If this energy is suddenly released by opening the valve or port quickly, the gases will bounce out of the cylinder and leave a very fine vacuum behind, just as a helical spring when compressed against the floor and suddenly released will jump several times its length into the air. This vacuum is ample to pull in one or more volumes of air for scavenging or recharging.

In the experiment mentioned I was using a cylinder with a constantly open port for the exhaust, and it is likely that some of the mixture filled the exhaust pipe. This pipe was 16 feet long by 2 inches in diameter at the port and tapering to 4 inches diameter at its open end. It was of No. 26 gage stove-pipe iron, double seamed and riveted, and stiff enough to carry a 200-pound man walking on it without much denting or flattening except right at the ends. But after a few strong explosions it was found flattened, almost shut, near the open end, the center of the flattened portion being between three and four feet from the end.

This flattening is due to the presence of a vacuum behind the outrushing gases, which vacuum permits the atmospheric pressure to crush the pipe. A vacuum of a pound or two is not uncommon, but that such a short column as three or four feet could produce vacuum enough to crush the pipe seems strange. It now looks possible to crush a three-joint stove-pipe by firing off a fire-cracker inside of it. CHARLES E. DUBYEA.

Philadelphia, Pa.

More Military and Naval Academies

To the Editor of the SCIENTIFIC AMERICAN:

While this discussion of America's unpreparedness for war is going on, I would like to cite a fact and make a suggestion or two. They say that we have not enough officers for our ships nor enough officers for our armies as they would be in time of war. This is perfectly true, in spite of the fatuity that boasts the raising of a million men over night.

Yet how easy it would be to provide officers! Here in this congressional district, Mr. Snyder, our Congressman, has had a score or more of applications for appointment to Annapolis and West Point. Just two boys have a good chance of going. A score of good patriotic boys are turned away without a chance, beyond the competitive examination, which is unfair in many ways.

Now why couldn't the military and naval academies be opened to every fit American lad who desires to prepare himself for service to the country on the supreme call? Why should appointments have to be bestowed by political or personal or even the ordinary competitive favor?

Let us have United States schools enough to graduate every competent and fit lad who desires education with an officer's training.

I would suggest that there be provided several naval academies and several military academies. Let West Point serve as one of these, and then have another academy out in the Middle West in another type of country, as the Upper Mississippi Valley around Rock Island, for example; a third academy would be located in the heart of the Rocky Mountains; a fourth in the Big Timber of Oregon or California, or in the swamp-plains country as along the Texas-Louisiana border.

Then rotate the classes; send the West Point first year boys to the Upper Mississippi for their second year; to the Rockies for their third year; to the Big Timber or to the land of bayous, shoal lakes, plains of the Louisiana-Texas country for the fourth year. Just consider what this training would give to each of the young men—right at their doors would be the kind of country they must fight over, if fight they must. It would give every one of them a broad intelligence regarding the United States which they cannot obtain in a four-year course in one place. They might even, with great advantage, march between terms from West Point to the Upper Mississippi and thence to the Rocky Mountain school, and thence to the fourth year school.

Each school would send out a first, second, third, and fourth year class, and the courses would be alike, and the nation's military schools would turn out several thousand men every year to serve in the reserve against the dreaded emergency, some few of special aptitude remaining for the army service life.

The naval schools would turn men out for the sea service, and there would be four of these naval schools—one as now; one on the Great Lakes; one on the Pacific; one on the Gulf of Mexico, with the rotation work. Thus these young men would learn on the ground the work of coast defense. They would not have to wait till after graduation; they were assigned to the Pacific Coast to learn the work on the ground and on the soundings. Let them pay for it, serving as stokers if need be on the battleship, turn and turn about.

There are tens of thousands of American youths who would be only too glad to have an opportunity to go through the rigorous training necessary to become officers of the sea or land forces. Thousands of them besiege the congressmen every year, pulling every political, social, and other wire in their eagerness to become soldiers in training. They offer the country their services—and they are sick at heart because they cannot gain appointments.

Why should the United States refuse these boys their wish? Why should any boy, desiring an officer's training, an officer's efficiency, be refused that training which would make them such valuable citizens to the country? Look how valuable they would be in civil life, where habits of discipline are so needed in every business! There they would do the country the greatest good—but they would be ready for the supreme service in any national emergency.

When we think of it, it is pitiful and it is shameful to think that the congressmen of the United States are obliged to refuse the requests of 15,000 or 20,000 boys who want to take and would pass the examinations for entrance into the army and navy schools for the thorough officers' training courses. These boys are most of them perfectly fit for the training. There isn't a congressman who isn't tormented by the fact that he must annually turn down a score of competent boys who now seek each appointment, in spite of the obstacles in the way.

Why should anybody, fit physically and mentally, be refused the boon of naval or military training, if he is willing to undergo the rigors, the privations and the discipline of the courses?

And if four academies for each branch of the service isn't enough to hold the eligibles, why not have six, or eight, or a sufficient number?

We spend millions upon millions making better onions, better hogs, better cattle, better minerals, woods, fruits. Why not spend a few millions in bettering the nation's protection by educating a sufficient number of training masters against an hour of need?

Little Falls, N. Y. RAYMOND S. SPEAR.

The Current Supplement

THAT the task the Allies have before them to reach Constantinople through the Dardanelles is by no means an easy one has become generally apparent, but the reasons are not so well understood. Some of these reasons are explained in an article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2061, for July 3rd, 1915, in which an excellent description of the numerous defenses that line the approach to the capital is given by a writer who has intimate personal knowledge of the subject. There is an excellent bird's eye map, indicating the difficult nature of the surrounding country, and numerous pictures illustrating incidents of the campaign. Public interest centers as much on aircraft as on submarines, and everyone will read with interest the description of a new type of flyer that can be stopped, as it floats in the air, and can alight vertically, instead of by a glide, that requires a considerable area of open ground, besides possessing many other original features. This machine has been actually built and tried out, and is illustrated by a number of photographs and diagrams. The first of two lectures on Photo-Electricity, treating of the intimate relations of light and electricity, by Prof. J. A. Fleming, appears in this issue, and will be welcomed by all interested in general scientific questions. There is another illustrated chapter on the subject of the Manufacture of Shrapnel Shells, this one dealing with the machine operations they pass through, and is as readable as its predecessors. Problems of Geographic Influence deal with the physical influences that are affected by environment and is a most interesting survey of the problem. The Manufacture of Condensed Milk is a subject that comes within the range of both technical and every-day life. The article on Coal Sampling gives valuable instructions in an essential preliminary to buying. The story of Italy's Engineering Achievements is timely as throwing light on the high technical abilities of this enterprising nation.

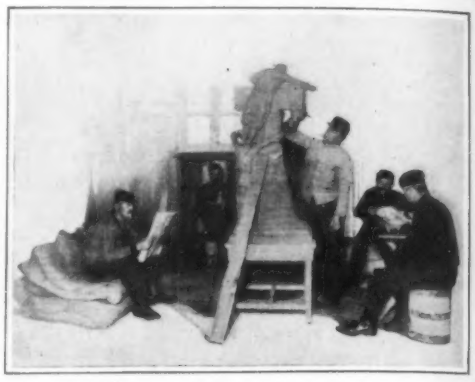
Attention may be called to the fact that this issue commences a new volume of the SUPPLEMENT, and that this is a good time to begin the regular reading of this valuable publication that so thoroughly and intelligently covers the fields of science and technical doings.

Whiling away the idle hours.

Science in German Concentration Camps

Necessary, Not Only for Humanitarian Reasons, But for Self-Preservation

By Dr. Alfred Gradenwitz



A prisoner with an artistic bent.

ONE of the most difficult problems in connection with the housing of war prisoners is the enforcing of rules likely to insure satisfactory sanitary conditions. In fact, the inmates of most German concentration camps are a remarkable medley of nations and races whose ideas of bodily cleanliness do not always conform to the European standard. While filth is one of the most potent factors in the spreading of disease, its invariable concomitant, vermin, has been found by recent research to be the carrier of infection with certain epidemics. Hygiene thus becomes a necessity not only for humanitarian reasons, but for motives of self-preservation.

The first care to be taken on the arrival of each fresh troop of prisoners, therefore, consists of cleaning their bodies and clothes as thoroughly as possible. This, in the case of Russian prisoners, is effected as follows:

The men, in groups of 50, are introduced into a hall where they are made to undress to the skin. While they are then administered a shower-bath, their clothes, made up in bundles, are thrown into a disinfecting oven, in order there to be exposed for about 20 minutes to the action of live steam, the most effective means of killing microbes as well as vermin. After the bath, the men are made to enter another hall, where their clothes are handed back to them. Most of them, however, must have their hair cut previous to this operation, thus ridding them of the most troublesome and dangerous of pests which in the present war has assumed unprecedented proportions, and which, apart from bodily discomfort, has been shown to be the carrier of petechial fever. Many other processes have been tried, but none has been found as effective against lice as the action of live steam.

Each barrack, housing 200 to 300 men, has its own wash-house, where the men are at liberty to wash their clothes as well as their bodies. Moreover, there are in each encampment, actual baths and shower-baths of adjustable temperature.

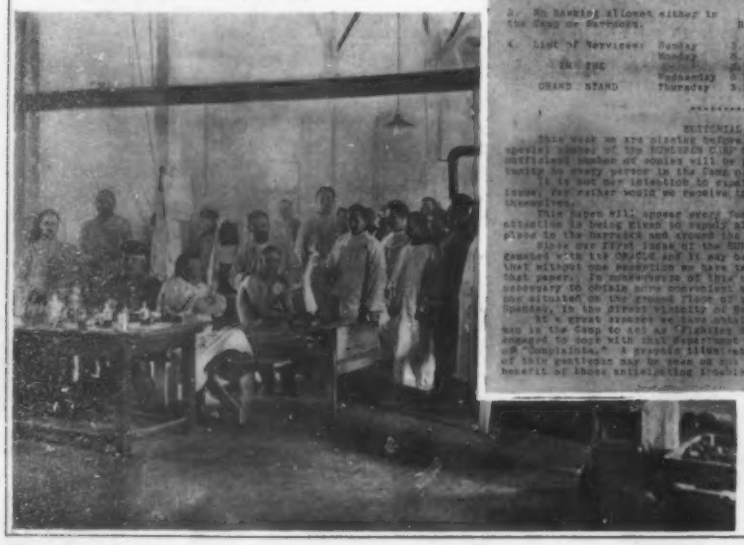
Another factor making for satisfactory sanitary conditions is an ample supply of good air. The barracks are spacious and well aerated, and the men are at liberty to walk about the grounds without any constraint. All the prisoners' camps are, moreover, situated in healthy surroundings, and some in woody, hilly districts.

Military drill and gymnastic exercises under the orders of the men's own superiors are made regularly to counteract the effects of protracted leisure. In fact, only part of the prisoners can be employed at some work or other—at the Zossen encampment only 3,000 out of a total of 15,000. Further evidence of the great amount of personal freedom left to the prisoners of war is found in the fact that they are allowed to play their native game, e. g., football.

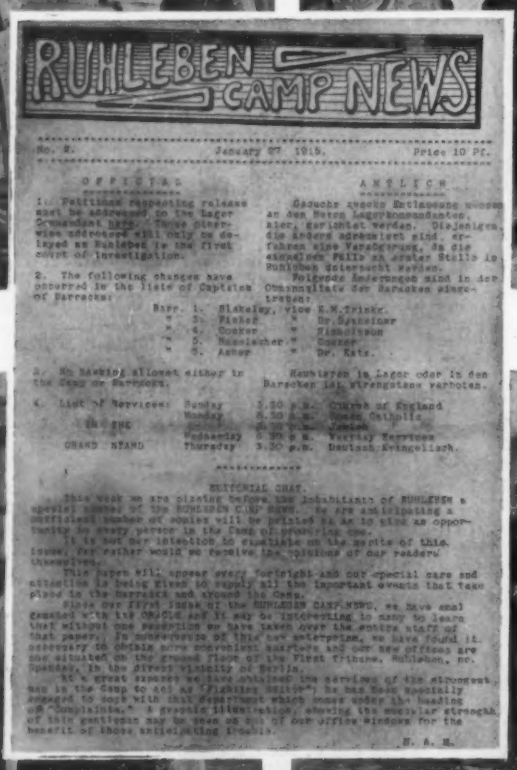
Great care is bestowed on the treatment of patients. Every morning the German doctors make the rounds of the barracks, when those feeling unwell are expected to report themselves sick. There are several stages in the medical treatment, those slightly unwell only calling at the ambulance, while those a little worse are sent to a hospital for slight complaints. Those somewhat more seriously ill go to the Encampment Hospital, while all really serious cases are referred to a large military hospital for treatment. The German doctors are often assisted by their foreign colleagues, and the chemists' shops are likewise conducted with the help of native chemists chosen among those interned at the encampment. Another instance of the great amount of liberty

Chemists' shop at Guben camp conducted by Russian as well as German chemists.

Disinfecting room for clothes at Russian prisoners' camp, at Guben, Germany.



A scene in the prisoners' hospital, the Döberitz encampment.



RUHLEBEN CAMP NEWS

No. 2. January 6th 1915. Price 10 Pf.

OFFICIAL

1. Petitions respecting release must be addressed to the Lager Commandant here. Those otherwise addressed will only be delayed as Ruhleben is the first court of investigation.

2. The following changes have occurred in the list of Captains of Barracks:

Barr. 1. Blakeley, vice E.M.Trinks.
" 3. Pinker " Dr.Spreimer
" 4. Cooper " Hinchliffe
" 5. Hunnicher " Cooper
" 6. Asher " Dr. Katz.

3. No Banking allowed either in the Camp or Barracks.

4. List of Services: Sunday 9.30 a.m. Church of England
Monday 8.30 a.m. Roman Catholic
Tuesday 3.30 p.m. Varsity Services
Thursday 3.30 p.m. Deutsch Evangelisch.

AMTLICH

Gesuche zwecks Entlassung müssen an den Herrn Lagerkommandanten, hier, gerichtet werden. Diejenigen, die anders adressiert sind, erfahren eine Verzögerung, da die eingehenden Fälle an erster Stelle in Ruhleben untersucht werden.

Folgende Änderungen sind in den Obmannschaften der Baracken eingetreten:

Barr. 1. Blakeley, vice E.M.Trinks.
" 3. Pinker " Dr.Spreimer
" 4. Cooper " Hinchliffe
" 5. Hunnicher " Cooper
" 6. Asher " Dr. Katz.

3. Kein Banking erlaubt weder im Lager oder in den Baracken.

4. Liste der Gottesdienste: Sonntag 9.30 a.m. Church of England
Montag 8.30 a.m. Roman Catholic
Dienstag 3.30 p.m. Jewish
Donnerstag 3.30 p.m. Varsity Services
Donnerstag 3.30 p.m. Deutsch Evangelisch.

EDITORIAL CHAT.

This week we are placing before the inhabitants of RUHLEBEN a special number of the RUHLEBEN CAMP NEWS. We are anticipating a sufficient number of copies will be printed so as to give an opportunity to every person in the Camp of procuring one.

It is not our intention to criticise on the merits of this issue, for rather would we receive the opinions of our readers themselves.

This paper will appear every fortnight and our special care and attention is being given to supply all the important events that take place in the Barracks and around the Camp.

Since our first issue of the RUHLEBEN CAMP NEWS, we have amalgamated with its CONTEMPORARY, and it may be interesting to many to learn that without one exception we have taken over the entire staff of that paper. In consequence of this new enterprise, we have found it necessary to obtain more convenient quarters and our new offices are now situated on the ground floor of the First Tribune, Ruhleben, opposite, to the direct vicinity of Berlin.

At a great expense we have obtained the services of the strongest man in the Camp to act as "Floating Reuter"; he has been specially engaged to deal with that department which comes under the heading of "Complaints." A graphic illustration, showing the muscular strength of this gentleman may be seen on one of our office windows for the benefit of those anticipating trouble.

E. A. M.

Sample page of official organ of Ruhleben camp, where English civil prisoners are interned.

Group of prisoners at meal time in one of the German camps.

enjoyed by prisoners is the fire brigade of the Guben Concentration Camp, which consists entirely of Russian war prisoners who are thus afforded an opportunity of useful exercise. Many camps, moreover, have their little newspaper issued by the prisoners in their own language; one of our pictures shows a sample of the official organ of the Ruhleben encampment, which gives evidence of the good spirits of its inhabitants. This comes also under the heading of sanitary measures, there being a hygiene of the soul as well as the body. The fact that prisoners are, in a certain measure, e. g., in the case of artists, allowed to exercise their own profession should finally be mentioned in the same connection.

Fifteen thousand Russians at Augustowa awaiting transportation to Germany.

The Verdict of the Insects

By Davina Waterson

IT will hardly be believed that the entomologist as well as the chemist is sometimes called in for the decision of various knotty questions concerning the date or the period of a murder.

After the human undertaker has done his work, certain flies, beetles, moths and spiders continue operating on a corpse, each set having its appointed time as decomposition advances, and never intruding on their predecessors; so, by the finding of certain minute insects, the expert can determine the date of death with tolerable accuracy, a test often applied by medico-legalists.

When the body is still fresh it attracts the Diptera Musca, Cyrtoneura and Calliphora.

After decomposition has set in, the flies Lucilia and Sarcophaga begin their task. Later, when fatty acids are formed (third to sixth month), come the beetle Dermestes and the moth Aglossia (the latter not common in cold countries). When the caseous or cheesy condition is present then there are found the beetles Pyophilia and Necrobia.

During a period lasting from the fourth to the eighth month there is liquefaction of the tissues into a blackish pulp, to the destroying of which swarm four more beetles, Necrophorus, Silpha, Hister, and Saprinus, and, along with these, four flies, Ophira, Thyreophora, Phora, and Louchea.

It would seem that not much would be left to feed upon, but nature is the most efficacious of all scavengers. The tissues are now drying up and are infested by Acari. When still drier, a second generation of Aglassa appear, with the beetles Attagenus and Anthrenus, also a moth, Tineola, as helper.

Finally, in about three years, when nothing but dry ligaments remain on the bones, two more beetles, Tenebrio and Ptinus, set to work on the completion of the long operation.

A diligent, trustworthy array of workers! No "cheap funerals;" no "royal burials"! King or pauper, all receive the same mortuary attention.

In earth-buried bodies and under certain climatic conditions, the insects are slightly varied, but enough occur universally to furnish correct data. It is true of all the flies that, from the time of depositing the egg to the appearance of the perfect insect, about four weeks are necessary. Empty pupa cases, therefore, strongly show life to have been extinct at least so long.

And, whatever the country, broad deductions can be made. Thus, wherever Acari are found, the Silpha and Hister have been at work. Pyophilia is only seen in well-marked saponification of the flesh. Dermestes is seen earlier in this process, but never in the preliminary decomposition.

Knowledge of that period of the year in which these insects breed in other countries is most important, though their order never varies, and, in a typical case, where the processes of decay can begin from the beginning (as in summer), eight detachments of workers can be traced.

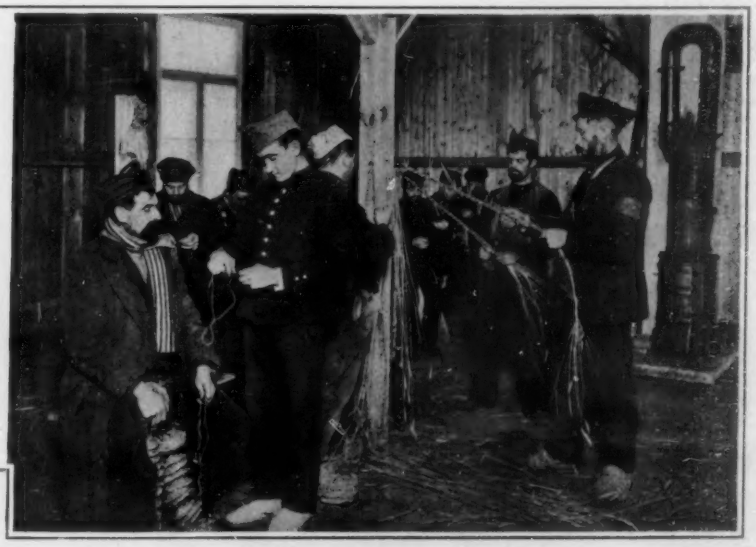
Dr. Mégnin of Paris reported a case on January 26th, 1883, illustrating the use of entomological knowledge:

The body of a new-born infant was found behind a panel in the Faubourg du Temple. The skin and underlying organs were almost intact, but still smelling strongly. The rarity of sarcophagous diptera (the first to begin work) showed the date of death was at a time when these were scarce; i. e., beginning or end of winter. But the abundance of Phorae, who do not come near decomposing matter unless half mummified, showed that when the fine weather came—the season when they are most plentiful—the mummification of the body was well advanced.

Lastly, the Arcarina (spiders) being few, and the Dermestes and Anthrenia, who work in the second year, absent, proved the baby had not been dead a year. The mother was arrested, and confessed she had killed her child in February, 1882.

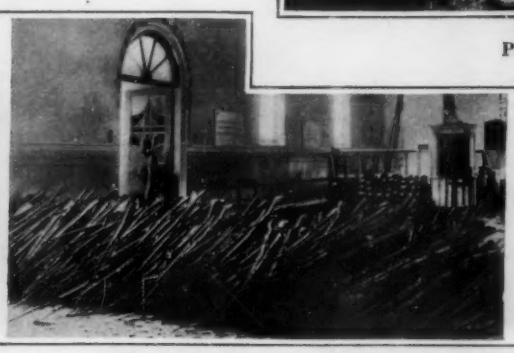
The Owner of a Patent cannot sell and assign his rights thereunder and through an older patent subsequently acquired by him deprive his assignee of the full benefit of what he purchased. This was decided in United Printing Machine Company v. Cross Paper Feed Company, 220 Fed., Rep. 322.

Russian prisoners' own fire brigade.



Prisoners making baskets of straw.

Lined up at one of the food counters.



Russian rifles captured in the Masurian Lake region.

Bringing in a load of firewood.

Austria's Famous "Skoda" Mortars

The powerful weapon which assisted in the reduction of Liege, Namur, Maubeuge, Givet, Antwerp and Przemysl. It requires a crew of 200 men.

Its range is so great that an enemy would have to march two hours to capture it—sufficient time for its dismemberment and removal.

SKODA mortars having a caliber of 30.5 centimeters (12 inches) were used in the reduction of the fortifications of Liège, Namur, Maubeuge, Givet, Antwerp, and Przemysl. The accuracy of fire of these mortars is such that a cupola at Antwerp, invisible to the gunners and aimed at by taking its position from a map, was pierced by a shell from a Skoda mortar at a distance of 12 kilometers (7.5 miles). This cupola, with part of the shell imbedded in it, has been presented by the German Kaiser to the Austrian Army Museum in Vienna.

It was assumed, at first, that the reduction of the Belgian forts was accomplished entirely by the 42-centimeters (16.5-inch) Krupp mortars. Such mortars are in existence and they appear to have been used at Liège and Antwerp, although no one has seen them, and we hear of only one such gun, the "Big Bertha." That the platforms of these German mortars are imbedded in concrete, from which they can be released only by blasting, diminishes their value for offense. Guns of equally great caliber had already been constructed by Skoda and in England, for ships and coast fortifications. The novelty in these guns consists in their mobility and in the frightful effect of their shells, which do not burst until after they have penetrated the armor or concrete of a fortification.

The Krupp mortar is said to require a crew of several score of men and six hours' work for its emplacement. The Skoda mortar is in little danger of being captured, as the time consumed by the enemy's advance over its long range (say forty minutes) suffices for its dismemberment and removal.

If we compare the long Russian siege of Przemysl, which indeed succumbed to lack of food, with the rapid destruction of the Belgian and French fortifications, we can appreciate the importance and value of the Skoda mortars in the present war. What all the Japanese, French, and Russian guns could not do at Przemysl, was done in Belgium and France by a few shots from the Skoda mortars, and Antwerp was the second strongest fortified place in the world.

The production of a gun so heavy, and yet so remarkably accurate and *mobile*, was no easy task. The idea, conceived in 1907, was gradually developed until, on July 22nd, 1910, the first of the new mortars was fired with complete success on the proving ground of the Skoda Works near Pilsen.

The 12-inch Skoda mortar is a recoiling gun. It fires a shell weighing about 390 kilogrammes (860 pounds) with an initial velocity of 340 meters (1,115 feet) per second. The work of the recoil is absorbed by a liquid brake, and the gun is replaced in the firing position by air pressure. The brake is attached above, the air compressor beneath the gun. The mortar is loaded in the horizontal position. The maximum horizontal range is about 12 kilometers.

The barrel is built up of steel cylinders according to a method of construction that has stood the test of many years of experience. Some of these mortars have been fired four hundred times in the present war. An experimental gun of this construction was fired more than six hundred times, without showing appreciable erosion or decrease in accuracy.

The breech block is of a novel horizontal wedge type and is operated from the right side. The shell is filled with a very powerful high explosive and is provided with a delayed-action fuse, so that it penetrates deeply before it explodes. The base of the gun mount is set directly on hard ground, but a portable foundation is interposed when the ground is soft. In the latter case the gun can be swung 60 degrees to right or left of its median position. The range of deviation is smaller when the foundation is not used.

Hoisting the 858-pound shell into position for loading.

The sighting telescope and the aiming and elevating mechanism are placed at the left side of the mount, from the back of which hangs the loading platform, carrying a loading pan which can be raised by levers. The shell is brought to the gun on a hand car and rolled onto the loading pan. The pan is then raised and the shell is pushed into the breech. The gun is transported by three Skoda-Daimler motorcars of 100 horse-power with four driving wheels—a construction patented by the Archduke Leopold Salvator. The gun is carried on one car, the gun mount on another, and the foundation, which is made in three sections, hinged together, on a third. The highest speed of the train is 20 kilometers (12.5 miles) per hour, which is a very good speed for heavily loaded cars with iron tires. At the lowest speed of about 2.5 kilometers (1.5 miles) per hour grades of 16 per cent can be ascended.

The mortar is usually mounted in a pit, into which the foundation is lowered by winches on its car. The car that carries the mount is then driven onto the foundation, and the mount is lowered in the same way and bolted securely to the foundation. Then the third car is brought up and the gun is drawn into its cradle and connected with the liquid brake and the air compressor. The entire operation of mounting the mortar has been performed in 24 minutes and it can always be completed easily in 40 minutes. The rapidity of fire can be pushed to one shot per minute.

The excellence of material and construction was proved by an accident in practice in a mountainous country, when a car laden with a six-ton mortar plunged into a ravine 16 feet deep and overturned. The axles were bent and the car was damaged in other ways, but it was able to proceed to its destination, and the mortar was subsequently mounted ready for firing without any repairs being made.

These heavy mortars can also be used as field-pieces. The explosion of the shell can be timed precisely and it produces an annihilating effect upon troops marching in close formation. In Russian Poland an entire battery of artillery and a large number of infantry were thus annihilated, the men in the immediate vicinity of the explosion who were not hit by fragments of the shell being killed by the intense air pressure and the suffocating gases produced by the explosion.

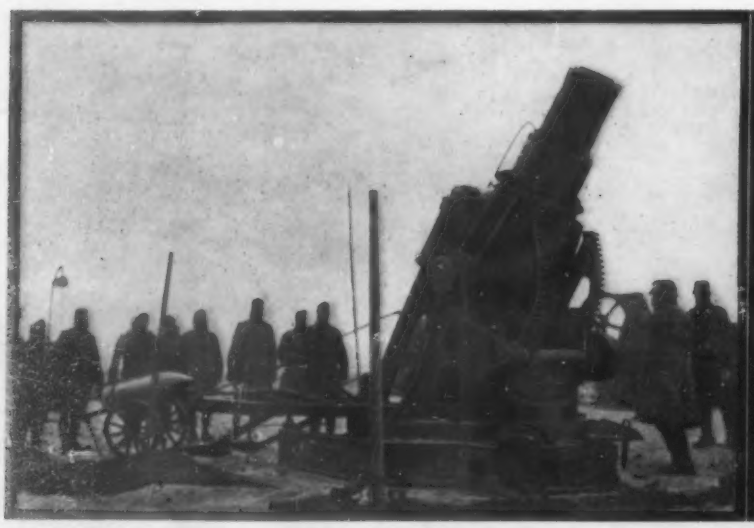
In Galicia and the Carpathian region a new Skoda howitzer, having a caliber of 42 centimeters (16.5 inches) was employed. This weapon, of course, is far less *mobile* than the 12-inch mortar.

The shells for all of these murderous weapons are made in Woellersdorf, Austria.

Franklin Medals Awarded to Onnes and Edison

AT a meeting of the Franklin Institute, held in Philadelphia on May 19th, the Franklin medal was presented to Prof. Heike Kammerlingh Onnes in recognition of his long continued inquiry and indefatigable labors in low temperature research. His Excellency, Chevalier Van Rappard, on behalf of the Royal Netherlands government, was present for Prof. Onnes.

At the same meeting a Franklin medal was also presented to Thomas A. Edison in recognition of the value of numerous basic inventions and discoveries. The Franklin medal is the highest recognition in the gift of the Franklin Institute and was founded in 1914 by Samuel Insull, and he received the sculptor's model of the medal.



Despite its great size the Skoda mortar can be transported at the rate of twelve and one half miles an hour.

The gun is loaded in the horizontal position. The maximum horizontal range is about twelve kilometers.

Bath Trains of the Russian Army

Each Train Can Daily Give a Bath to at Least 3.000 Soldiers. It Provides for the Serving of Refreshments and Affords Numerous Utility Advantages

THE bath is a great institution in Russia. People are accustomed to it, and even the smallest cottage has its little "banja" or steam bath house, where they get their weekly steaming.

During the present war several movable "banjas" or bath-trains have been constructed for the Russian army. The following short description gives a general idea of one of these trains.

As shown along the border of this page, the train consists of a locomotive and a score of cars. The cars of the bath-train are reconstructed passenger coaches of the third and fourth class and freight cars. All the cars are paneled with felt, cork and wood, to keep them warm, and are provided with everything that is necessary for each car according to its destination. The cars are joined by warm vestibule bellows, that make it possible for the soldiers to pass freely from the undressing car to the bath room and then to the dressing car.

The bath-train is lighted with electricity from the central electric station and heated by steam. The bath rooms are provided with hot water from the locomotive boiler. In the train there are two tank cars holding water necessary for twenty-four hours' work. Besides there is an electric pump by means of which water can be drawn from any source not farther than 50 to 100 Russian fathoms or 350 to 700 feet.

The undressing car has longitudinal benches with numbered seats. Each car has forty-eight seats. On entering the car each soldier receives a number check and takes a corresponding seat. He puts his outer clothing into one bag and his soiled linen into the other. These bags, also numbered, he finds under the bench and on the upper shelf. In this car the soldier may have his hair cut, and after that he passes to the washing department. Each department has twenty-four partitioned washing fittings and a steam-bath, while there are benches in the middle of the car.

The bath-car has several faucets for hot and cold water. Each fitting has a shower with a mixing cock. Every soldier receives a piece of soap, a bast-wisp for scrubbing, and a basin for suds. The steam-bath also has hot and cold water faucets and a shower in which the temperature of the water can be regulated.

While the soldiers are washing, the attendants of the train take the bags of dirty linen, disinfect it and pass it over to the store of dirty linen, while the bags of clothing are taken either into a special disinfecting compartment or into a special department for destroying parasites.

The dressing car is arranged in the same way as the undressing car. The soldier finds on his numbered seat a bag with a set of clean linen, and his clothes cleaned, mended and disinfected. When dressed he passes to the next car, which is called the tea room, where he can get tea, sugar, tobacco, etc.

The disinfecting compartment is designed for the disinfection of clothes, boots and fur jackets. It is operated with steam formalin. After the disinfection the compartment is filled with ammonia to take away the caustic odor of the formalin.

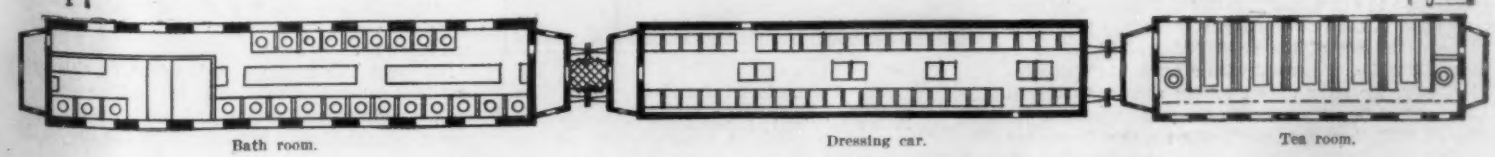
The compartment in which parasites are destroyed uses air heated to 100 deg. Cent. To kill the parasites it is enough to keep the bags in the rotating drums of the compartment for ten or fifteen minutes. The equipment of the other cars calls for no special comment. In one of the cars there is a cobbler shop, with instruments for mending boots, etc. The bath-train is provided with linen by special cars, that supply the stores from Petrograd and other towns.

At present there are three bath-trains in the Russian army. Each of them can daily give a bath to two or three thousand soldiers.

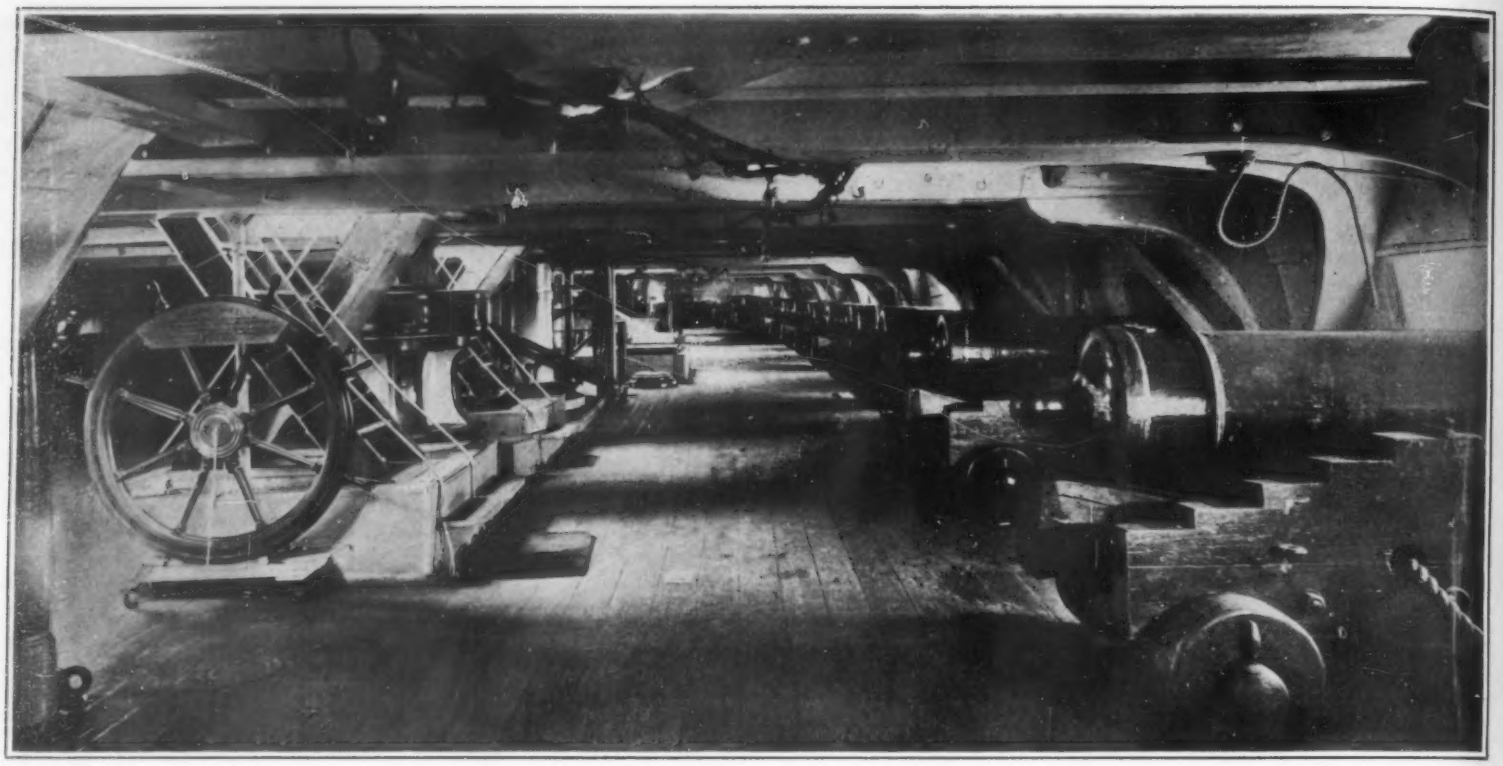
The cost of construction of such a bath-train depends upon the cars that are used and attains to 50 to 70 thousand rubles.

The cost of maintenance of a bath-train, including salary and boarding for the trained attendants and servants, fuel, etc., is 10,000 rubles per month, not counting the linen.

Interior of a bath car, showing the shower-baths at each side and the steam room in the middle.



Sectional plan view of three cars of a Russian army bath train.



The long 24-pounders on the gun-deck of the "Constitution."

The Fight Between the "Constitution" and the "Guerrière"

Naval Warfare as Carried on One Hundred Years Ago

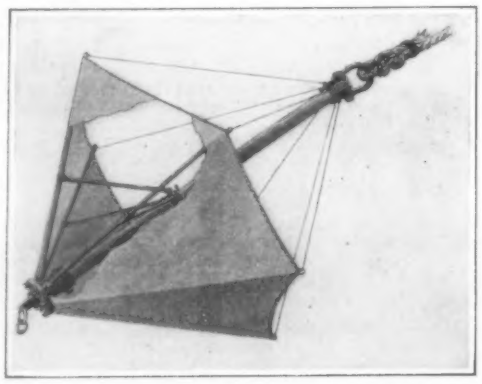
A COMPARISON of the naval fights of the present war, such as the battle-cruiser engagement in the North Sea and that other running fight off the Falkland Islands, with the sea fights of a hundred years ago which occurred during the war of 1812, affords striking evidence of the wonderful strides which have been made during the past century in the development of ships and the art of naval gunnery. A few months ago we were thrilled with the description of a running fight between British and German battle-cruisers, in which the ships were sweeping through the water at a speed of some thirty-three miles an hour and the guns were able to land on the enemy at a range of ten miles. Contrast this with the frigate engagement of a century ago in which the average speed was only a few miles an hour; when the effective range of the guns was something less than a mile; and when the commanders of the rival ships preferred to get so close that they could hold conversation, and the crews literally could see the whites of each others' eyes.

The present article is concerned with one of the most brilliant engagements of that war, when the American frigate "Constitution," under Commodore Hull, met and decisively defeated the British ship "Guerrière," commanded by Capt. Dacres. The ships engaged, the character of the fight and the gallant and courteous behavior of the combatants, were typical of that romantic age when men fought like gentlemen; when every effort was made to save the crew of the beaten ship; and when the humanitarian laws of war were observed to the letter so far as the exigencies of the situation permitted.

The brilliant work of the individual ships of the little American navy is the one bright feature of a war which was one long series of disasters for the United States. The pitiful failure of our land forces, except at New Orleans, carries a lesson for the United States of to-day—the lesson of the folly of unpreparedness. Had the young republic listened to and followed the warning of its great soldier President and made reasonable defensive preparations on sea and land, the history of that war would be portrayed in very different colors.

Although the navy as a whole achieved no success in fleet engagements, thanks to the neglect of Congress, the work done by individual ships in duel engagements with the enemy afforded clear proof that had the navy received the proper support of Congress it might well have changed the whole course of the war.

It is no disparagement of the success of the American frigate to draw attention to the fact that, in gunnery at least, the British navy, subsequently to Trafalgar and the era of the great Nelson, had fallen to a very low ebb. Possessed with a sense of its own invincibility, the navy almost totally neglected its gunnery, and of target practice in the years preceding the war of 1812, there was practically none so far as the records of that day can enlighten us. True it is that even in that period of self-complacency the ships themselves were maintained in a state of high efficiency and admirably handled, and were resplendent in paint, polish and well-found gear. Also it is true that, though gunnery was neglected, the navy even at that day had its Sir Percy Scott. Here and there was found a captain who realized that battles were to be won only by good shooting. A notable instance of this was Capt. Broke of the British ship "Shannon," and to the fact that he exercised his gun crews continually in target practice, and that he made certain notable improvements in the sighting of the guns, was due his victory over the "Chesapeake" and that brilliant sea-fighter Lawrence. These men, however, were the rare exceptions, and when the war of 1812 opened, the British sea captains believed that the only way to fight an enemy was to get up very close to him and pound away blindly at a range so close that it was impossible to miss the target.



Sea-anchor of the "Constitution," used to keep the frigate head to wind in a gale of wind. The pull on the cable opens the drag, exposing a large area to the sea.

Commodore Isaac Hull.

From a painting by Gilbert Stuart, owned by Charles A. Munn.

No such reactionary spirit prevailed, however, in the young United States navy. Here it was realized that the sooner you could reach your enemy with a well-directed fire, the better were your chances of winning the fight. Our guns were lengthened, their range was greater, and the projectiles were heavier on the average than those of the British ships of that day. Moreover, the men were exercised at gunnery, and frequently, when they met the British frigates, an accurate fire delivered early in the engagement so crippled the enemy that sometimes the issue of the fight was a foregone conclusion before it had been many minutes under way.

The engagement between the "Constitution" and the "Guerrière" took place in the region of the Grand Banks, and Hull was enabled to get in touch with the British ship because of information given him by an American brig, the captain of which informed Hull that he had sighted a British frigate cruising somewhat to the southward of Hull's position. Hull made sail on the indicated course, and at 2 P. M. on the 19th of August the enemy was sighted, and the "Constitution" with all sails set to a good breeze bore down for the attack. The "Guerrière," which was on her way from the British squadron off New York to Halifax for overhauling and new equipment, waited for the enemy. At 5:05 P. M. she let go a starboard broadside at the "Constitution," but failed to score a hit. She then wore around and discharged her port broadside, two of the shots taking effect. For the first three quarters of an hour the British ship fired alternate broadsides, the American ship yawing to avoid being raked, head-on, and firing her bow guns.

Not much execution was being done on either side, and Hull determined to close in for decisive work. He set his main top-gallant sail and headed down for the enemy, placing himself to windward of the British ship,

and on her port quarter. The "Constitution" was the better sailer, and she steadily overhauled the "Guerriere." At 6:05 P. M. both ships opened with full broadsides and the battle was on in good earnest. Hull reserved his fire until he felt that the critical moment had come, and in ten minutes after he opened with his whole broadside, the "Guerrière's" mizzen mast was struck by a shot and went over on the starboard or leeward side. Ira N. Hollis, in his excellent work on the "Constitution," states that when this happened, one of the American sailors exclaimed, "Damn it, Jack, but we have made a brig of her!" The "Constitution" continued to surge ahead, approximately 200 yards away on the port beam of the enemy and when he was well clear Hull put his helm a-port to cross the bow of the "Guerrière" and pour in a raking broadside. The ship, however, disabled in her rigging and gear, swung too slowly, and after two broadsides had raked the enemy, doing great execution, the "Guerrière's" bowsprit and jibboom fouled the lee mizzen rigging of the "Constitution" as the latter swept by.

According to the log book of the "Guerrière" the wreckage of the fallen mizzen mast brought that ship up into the wind against her helm, and exposed her to a heavy raking fire. In any case her standing rigging was greatly weakened, and as the "Constitution" pulled clear the two remaining masts of the "Guerrière," the fore mast and the main mast, went by the board and left her a total wreck, rolling her main deck guns under water. She was then in the condition shown in our engraving on the cover of this issue.

By 6:30 Capt. Dacres, realizing that the ship was lost, fired a shot to leeward and surrendered. When Lieut. George C. Read of the "Constitution" boarded the "Guerrière" he found that she was in a sinking condition and that the fire of the "Constitution" had in some places knocked adjacent portholes into one, tearing out the ship's side. The complement of the "Guerrière" was 282 men; 15 had been killed during the action, and 267 surrendered. Of these ten were Americans, who were sent below to spare them from serving against their own countrymen.

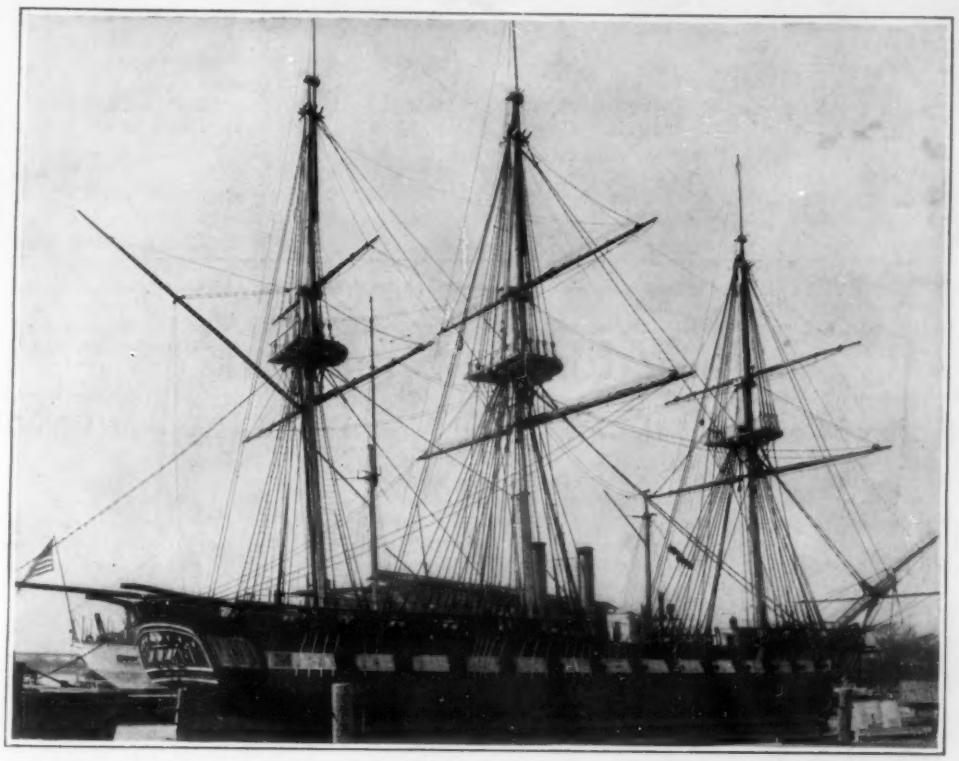
The "Constitution" carried 456 officers and men, and she mounted the more powerful battery. It consisted of thirty long 24-pounders on the gun deck, twenty-two 32-pound carronades on the spar deck, two long 24-pounders, and one long 18-pounder on the forecastle, making a total of 55 guns firing a total broadside of 684 pounds.

The "Guerrière" carried thirty long 18-pounders on the gun deck, two long 12-pounders, one 18-pound carronade, sixteen 32-pound carronades on the spar deck, making a total of 49 guns, firing a broadside of 556 pounds. The losses on the "Guerrière" were 15 killed and 63 wounded; the "Constitution" lost 7 killed and 7 were wounded.

As the "Guerrière" was found to be in a sinking condition and it was impossible to tow her into port, the crew was removed and the ship set on fire.

Having in mind the ferocity which has marked the present war, we cannot refrain from including the testimony of Capt. Dacres to the humanity of his captors in his report to Vice-Admiral Sawyer, as given in Hollis's book. Says he of his captors: "I feel it my duty to state that the conduct of Capt. Hull and his officers to our men was that of a brave enemy, the greatest care being taken to prevent our men losing the smallest trifle, and the greatest attention being paid to the wounded."

The American shipwrights of that early day builded well; for the "Constitution" has survived and become one of the most famous, if not the most famous relic of those stirring times. Some 15 years ago Congress made an appropriation for the purpose of restoring this ship to the identical condition in which she fought the "Guerrière." A careful search of the naval records rendered it possible to reproduce the ship with great fidelity, and hence the accompanying photographs will possess unusual interest as showing what the fighting frigate of that day was like.



The "Constitution," fully re-rigged and equipped, as she appeared when she fought the "Guerrière."

The spar deck of the "Constitution," showing starboard battery of 32-pound carronades.

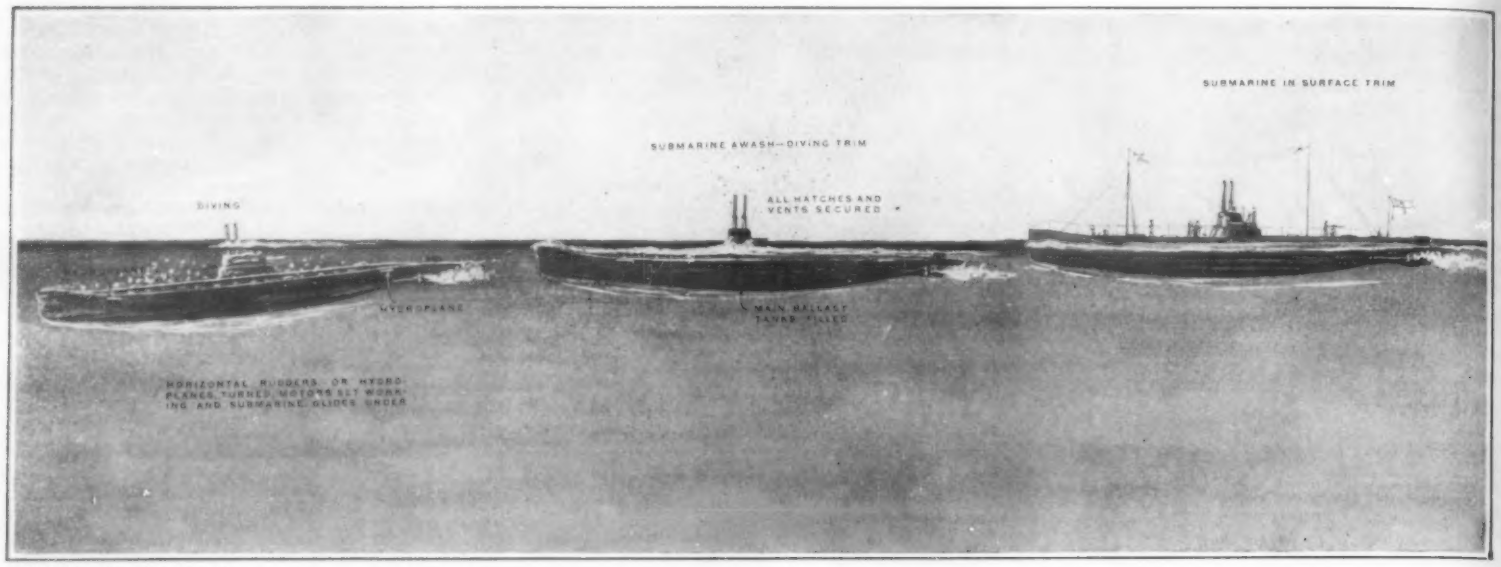
Where Electricity Saves the Seconds

IF there is any application of electricity that is in a class by itself with respect to convenience and quick service it is its use in the modern fire alarm telegraph system. Everyone realizes this in a general way, but it takes the specific instance to bring the point home. A few days ago a correspondent happened to be within three feet of a fire alarm box in downtown Boston when it was "pulled" for a small blaze down the street, and for curiosity's sake timed the arrival of the apparatus. In 1 minute 25 seconds from the pulling of the hook a ladder truck galloped into the street opposite the fire; in 14 seconds more the motor car of a district chief shot around the box corner; and in 2 minutes from the alarm four pieces of apparatus were on the spot. In 25 seconds more two additional engines swept into place and 3 minutes and 25 seconds from the giving of the signal no less than ten fire-fighting units were assembled. The fire was drowned out in a few moments with this splendid mobilization, which is simply the everyday practice of the department and one doubtless duplicated constantly in other well-appointed cities.

Now it is only calling attention to the obvious to point out the impossibility of accomplishing such a rapid concentration without electricity, but it is a good thing even so to realize now and then how much civilization depends on these familiar applications for its comfortable continuance. In the case cited there were no electrically driven units to respond to the alarm, but the time is coming when the reliability, superior acceleration, and 100 per cent readiness for service without a "hitch-up" enjoyed by the electrically driven equipment now in service in a few cities will be more generally appreciated. Battery charging for such apparatus does not add much to central station revenue, but it can be done in most cases off the peak, is profitable so far as it goes, and is one of the best possible advertisements to the public of the all-around convenience of electric service.

Paris Water Sterilizing Plant

THE city of Paris is now operating a large plant in the suburbs which is designed for filtering and sterilizing the water of the Marne River, and the present plant can supply about 2,500,000 cubic feet of water daily. Sterilizing after filtration in sand filtering basins is done by the ozone method, and the results are most satisfactory, especially in the absence of the coli bacillus with which the Marne water is charged. Clarified water from the filters is sent by rotary pumps to a series of ten ozonizing tanks or columns. Above the range of columns is a large cross collector, or circular feed tank, of three feet diameter, and the water descends from it into each column, passing on its way through aspirator nozzles so as to draw in ozonized air along with the water. Contact with the ozone is obtained in the water column, then the purified water flows out by a top orifice and is aerated by cascading, then goes into the offtake piping. An elaborate plant is used for the production of ozone, and before going into the electric ozonizers the air is dried by condensation of moisture in a set of freezing chambers, in which a temperature of —2 deg. Cent. is maintained by worm piping having a circulation of chloride of methyl, this being liquefied by two vertical machines of large output. Two air fans deliver the dried air into the ozonizers. Four electrically driven centrifugal pumps are used to deliver the filtered water to the sterilizing columns. The present plant is operated by the municipality of Paris.


SUBMARINE IN SURFACE TRIM
SUBMARINE AWASH—DIVING TRIM
DIVING
ALL HATCHES AND VENTS SECURED
HYDROPLANE
MAIN BALLAST TANKS FILLED
HORIZONTAL RUDDERS OR HYDROPLANES TURNED, MOTORS SET WORKING AND SUBMARINE GLIDES UNDER

Illustrations redrawn from the *Sphere*.

Three positions of the submarine—for surface navigation; awash; and diving.

The Modern Submarine

Methods of Control of the Latest and Most Dreaded Type of Warship

BOTH in its moral and material effects the submarine has certainly established itself for all time as one of the most formidable weapons of naval warfare. We say this without any reference to the sinking of unarmed merchant ships; for that is a savage abuse of an otherwise efficient and legitimate instrument of warfare. It is difficult to say whether in its moral or material effect the submarine has proved more useful in the present war. Its material results are seen in the sending to the bottom with a single blow of cruisers and battleships, some of which were supposed to be able to take the blow of at least two torpedoes without foundering. Its moral effect it is impossible to gage; but undoubtedly the dread of this potent craft has exercised an enormous effect upon the strategy and tactics of the present war.

We have only to consider the operations of the Allies at the Dardanelles to understand how greatly this new and comparatively untried type of ship is liable to upset the whole of an elaborately-conceived and hitherto well-carried-out campaign. We refer to the torpedoing of two battleships of the Allies which were engaged in supporting the land operations of the allied troops on the Gallipoli Peninsula. These troops depended upon the co-operation of the ships for the success of their sweeping operations designed to capture the whole peninsula. It is the duty of the ships to take care of the flanks and to enfilade the enemy's trenches from both coasts of the Gallipoli Peninsula.

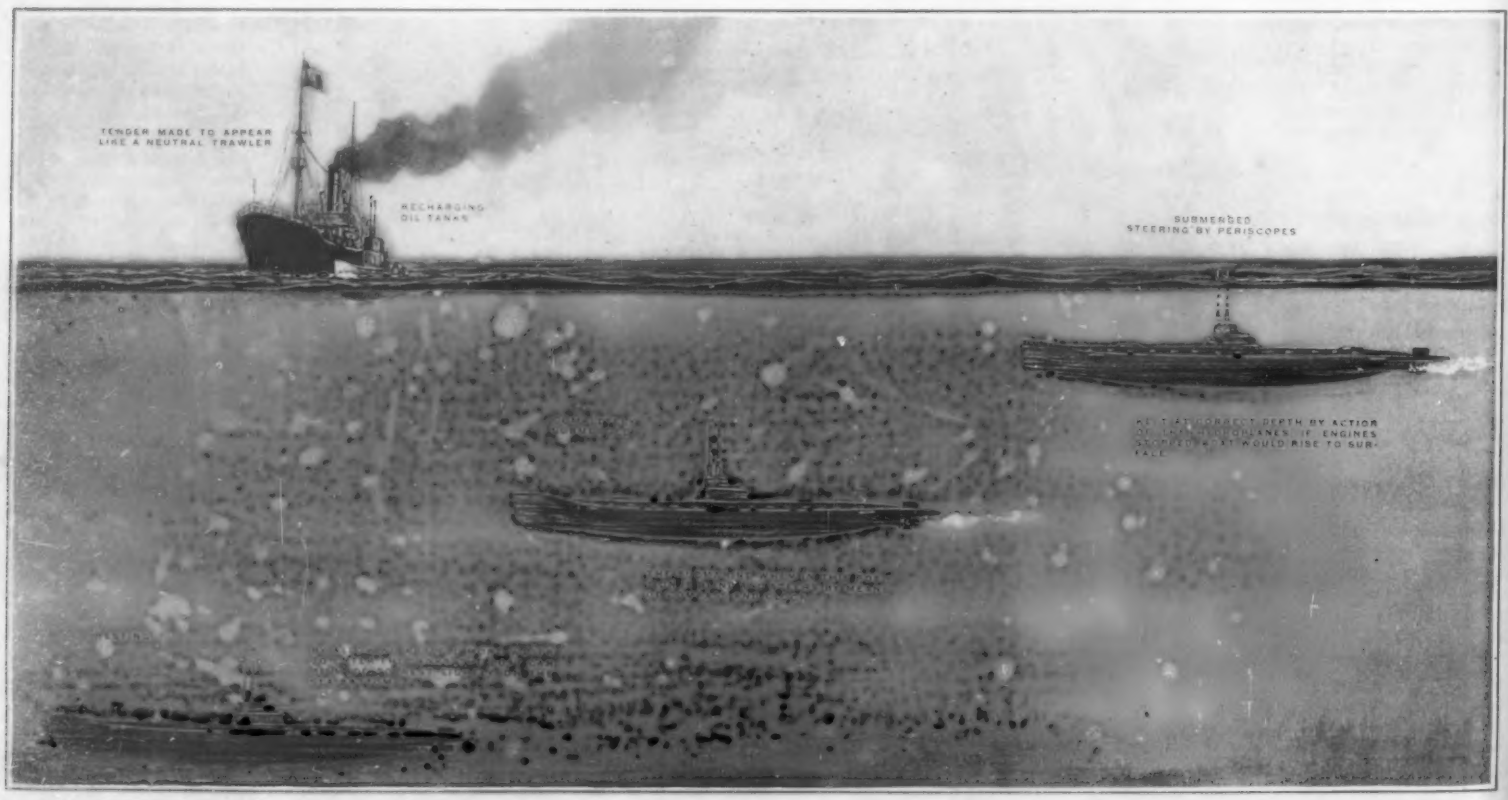
Furthermore, upon the warships and transports the landing forces undoubtedly depend for a considerable part of their subsistence and certainly for all of their military supplies. A recent Associated Press dispatch states that the fleet, subsequently to the appearance of submarines and the loss of the two battleships, has been drawn up and anchored off one of the adjacent islands where, doubtless, it is surrounding itself with mine fields and nets as a protection against submarine attack.

It is possible that, by increasing the force of destroyers, the ships may be able to resume their flanking operations on each coast, but the menace is there and it has to be reckoned with.

By the courtesy of our contemporary, *The Sphere*, we reproduce a set of illustrations showing the German type of submarine in various stages of flotation, such as at the surface, awash, diving, on the bottom, and when discharging a torpedo.

The flotation of the submarine, or its position with regard to the surface of the water, is determined partly by the operation of compressed air and water ballast tanks and partly by the reaction of horizontal diving rudders. At the surface and in the cruising condition the modern submarine has considerable freeboard, as will be seen from our illustration. The decks are well above water, the craft is able to open her hatches, and the ship is navigated from the bridge, in the same way as an ordinary surface vessel. The German type has a long, flat deck, carried upon a light superstructure which has nothing to do with the flotation of the ship, being freely perforated to allow the water to enter and leave at will. The deck is surrounded by a rail consisting of stanchions and wire rope. She carries two masts hinged at the deck, which can be raised to the vertical position for carrying the wireless, as shown in the engraving. When the ship is going to submerge the wireless is removed, the two masts are folded on deck and secured, the hand railing is taken down and sent below, as are also the bridge and its fittings. After the last of the crew has disappeared through the hatchway, it is closed and bolted securely from within.

The second illustration shows the submarine in the awash condition, the main ballast tanks being filled, all hatches and other openings being tightly secured. In this condition she has a slight reserve buoyancy of a few hundred pounds. The oil engines are now disconnected and the electric motors are started. As soon as she has way on, the horizontal diving planes are depressed and the ship descends at a moderate angle until the desired depth is reached. The small, reserve buoyancy tends to make the boat rise to the surface, and



View showing a German submarine recharging its fuel tanks; traveling with the periscopes exposed; in the submerged condition; and "asleep on the bottom."

this is counteracted by maintaining a slight degree of horizontal helm.

Inside the boat is a pressure diagram which shows the depth at which the boat is traveling, and by this the man who controls the horizontal rudders is guided.

For attack, the boat is sunk until just the tops of the periscopes are above water, and through these the commander has clear vision, the view being very much the same as would be obtained were he standing at the surface with good binoculars at his eyes.

Should an enemy ship approach, a slight additional depression of the diving rudders brings the boat down until its periscopes are entirely below water. In this position the immersion indicator will guide him as to his depth, and he lays his course by a ship's compass, steering the boat in the horizontal plane by means of the vertical rudders at the stern.

If the enemy is numerous and the commander wishes to play safe, he admits sufficient water to destroy the reserve buoyancy and settles quietly to the bottom. This is known as "going to sleep." When the commander wishes to rise to the surface, he can do so by admitting compressed air to the ballast tank, and blowing out a portion of the water, and starting his electric motors. Then, by lifting his horizontal planes, he can come to the surface, where and as rapidly as he desires.

The latest and largest German submarines, with a surface displacement of 800 to 1,000 tons, have a wide radius of action; for when running at low speed at the surface they can probably travel from five to seven thousand miles without replenishing their oil tanks. Their maximum speed at the surface is about 18 knots, and possibly 20 in the later type, and submerged they can speed about 10 or 11 knots with a radius of possibly 100 miles. Ten or a dozen torpedoes are carried on these boats, and some of them have four torpedo tubes ahead and two astern, making it possible for them to fire the whole of their torpedoes in quick succession if the exigencies of the situation call for it. The submarine is the gun, the torpedo the projectile, and the whole submarine must be steered to point in the direction of fire before the torpedo is let go. This, because of the comparatively slow maneuvering ability of the submarine, is a handicap, and many a miss is made because of the difficulty of "laying" the submarine true to the mark.

The question of fuel supply is solved by providing oil tenders for each flotilla of submarines. The oil tender may be a trawler, tug or any small vessel, and if it flies a neutral flag it has a good chance to meet the submarines in some designated locality and replenish their fuel tanks. This is done by passing hose from the tender to the submarine and pumping the oil direct to the fuel tanks.

Air Races Postponed

THE Aero Club of America announces that the conditions due to the war have made it impossible to hold the extended series of contests planned for this summer, and therefore it has been found necessary to postpone them indefinitely. The large orders from the countries at war are so fully occupying the attention of all builders of aeroplanes and motors that they cannot give their time to the proposed races, which were to have commenced on July 4th, and moreover, all of the qualified aviators are engaged with these manufacturers.

Inventors and the War

IF the patent reports are to be believed, the war has acted on the minds of our inventors as the famous ginger injection did on the balky mule.

It is to be expected that the hugely increased demands for war material should stimulate inventors and it is not surprising that the gentlemen of fertile minds stepped into the breech when modern methods of fighting showed the need for something new. The amusing part of the programme is that about half the earnest gentlemen hastening to tie up against theft their precious ideas as to war material, are people without the slightest practical knowledge of the conditions of modern war.

Apparently the bullet-proof shield is the favorite article among the amateur inventors. *The Sporting Goods Review* of England lists no less than eleven applications for patent on devices of this sort, for one month.

A chap came to me in Los Angeles not long ago. You can tell the amateur inventor by the deeply mysterious air, which is compounded with a mien of intense satisfaction.

He had a square piece of steel, possibly five sixteenths inch thick, and a foot each way. He wanted to know, he said, if a rifle was made that could shoot through that steel. He refused with darkly mysterious refusal to tell me why he wanted to know, but he intimated modestly that if things were as he believed them to be, he would just about wind up the war.

The steel, he said, was silver-steel, whatever that means, and the toughest steel on earth. The hardware people had told him this and he believed them.

I told him that about sixteen different rifles of my acquaintance would shoot through that steel at the muzzle unless it were chilled, while rifles like the German Mauser or the United States Springfield with match bullet, or the 0.280 Canadian Ross, would just about go through it at 400 yards. The look I got spelled liar, although he didn't say it.

So we took him down in the basement of a sporting goods store, with a little 0.250 Savage, a sporting rifle with but 1,700 foot-pounds muzzle energy, against about 3,000 for the German Mauser, and with a tiny 87-grain soft point bullet. And the little bullet romped through the steel without hesitation. I knew that it got nearly through a half inch of soft steel, but forbore to say this, not knowing how tough his sample might be.

Then the mysterious invention came out.

It was to be a portable trench.

It was to be picked up by the men advancing and put down at every halt, and it was to do all the work a really-truly dirt trench would do with all the advantages of being able to take it along with you if you got tired of the scenery.

I was impressed. Merely to satisfy the last remaining scruple and remove the last shred of doubt, I inquired what happened to it and its inhabitants if a battery or two were turned on the trench, but this did not feaze the amateur. It would stop shrapnel, he said. High explosive shells evidently did not enter into his computations.

I also learned that the sections of the trench could be easily carried by the poor footman in addition to his pack of sixty-odd pounds!

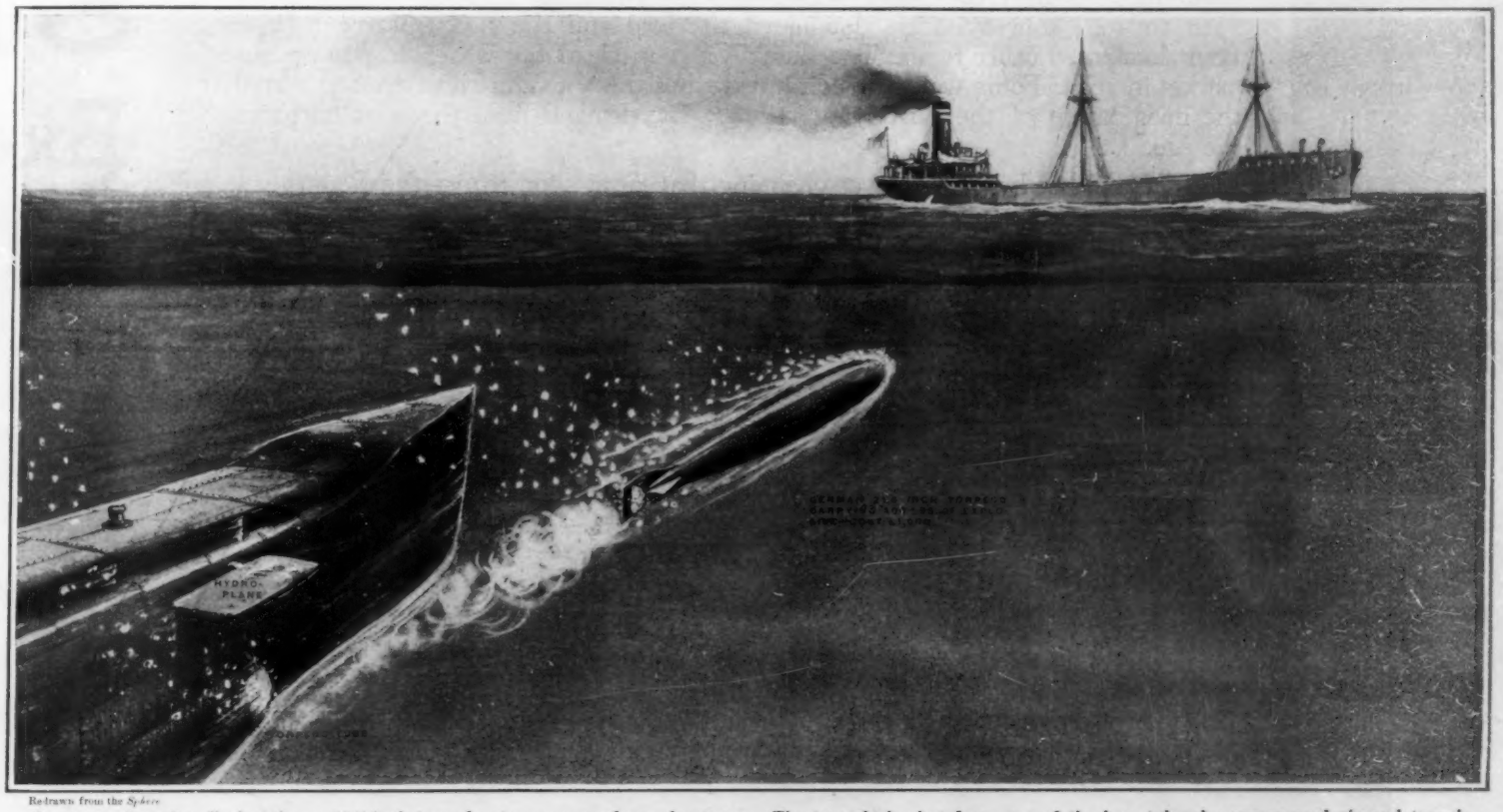
The bullet-proof shield or garment has been an obsession of the amateur inventor for lo, these many years, and he is particularly violent in these parlous times.

As a matter of fact, a form of shield is used by a few men in each army, snipers, men crawling out to dig advanced trenches, etc.; but this sort of thing on a huge scale is unthinkable because of the necessary weight of a shield heavy enough to stop a pointed high-speed jacket bullet at comparatively short range. My tests with ordinary mild steel showed a penetration of one quarter inch at 500 yards for both the Ross and the United States rifle with match 180-grain bullet.

The United States rifle with a service bullet goes 0.44 inch into mild steel at the muzzle and penetrated a high carbon steel plate 0.38 inch thick. Steel only one quarter inch thick weighs 10 pounds per square foot of area.

It is possible a material might be found to resist even modern bullets and still be light in weight, but it is not yet with us. High carbon steel, chilled, is the best bullet discourager now available.

I wonder why a man without the knowledge of the first principles of modern war, and without the most remote idea of the power of the modern rifle, will set himself to "inventing" military equipment of this sort.



Redrawn from the *Sphere*

German submarine discharging a 21.5-inch torpedo at an unarmed merchantman. The torpedo is shot from one of the bow tubes by compressed air and travels under its own power at a speed of 30 to 40 knots.

A New Ford Enterprise

THE announcement is authoritatively made that Henry Ford has practically perfected an automobile tractor, upon which he has been working for a long time, and that within a few years he expects to develop an immense new plant at Dearborn, Mich., where these machines will be built. Nothing in the way of details nor of the character of this tractor has yet been given out; but the inventor says that it will be of world-wide importance in reducing the labor of tilling the soil and doing the heavy work on the farm, with a corresponding effect in reducing the cost of food. It will take ten years to fully develop the new plant where ultimately he expects to make all the motors required for both his automobiles and tractors, all the ironwork being done here. Mr. Ford has acquired over 2,000 acres of land at the new site, which adjoins his farm where he now goes for relaxation, and of this the new works will occupy about 600 acres. On a portion of the remaining property a new town will be provided for, to accommodate the employees.

Buick Announcement

PIONEER BUILDERS OF VALVE-IN-HEAD MOTOR CARS

The public wants Buick Sixes—so many of them that we shall build nothing else in 1916.

More enduring than chrome vanadium steel, more wonderful than the finest workmanship, is the idea that can dominate an industry.

In this day when more Buicks are being built than ever before it is interesting to remember that the distinguishing characteristic of the Buick, the Valve-in-Head Motor, has existed as an idea for twenty-five years and been built into Buick cars for thirteen years.

From 1903 to 1907 the Buick Valve-in-Head was a two-cylinder engine. From 1908 to 1914 four cylinders dominated the field and the Buick Valve-in-Head Four dominated other types. The Buick Valve-in-Head Six was first put on the market in 1913. Fours were also continued—but the Valve-in-Head Six had stirred the imagination of the car-buying public. The demand from the start outpaced the production.

This demand has become so overwhelming that now—for 1916—the Four gives way to Sixes. Two chassis, both Sixes, with roadster, touring car, coupé, sedan bodies. The Six has been made standard because in the Six the Valve-in-Head idea has its greatest opportunity for service. Also since the first appearance of the Buick Six there has arisen an insistent demand for smaller Buick Sixes.

The Six is a natural, logical, efficient form for the Valve-in-Head type. Never before has the Valve-in-Head idea had such adequate materialization.

19
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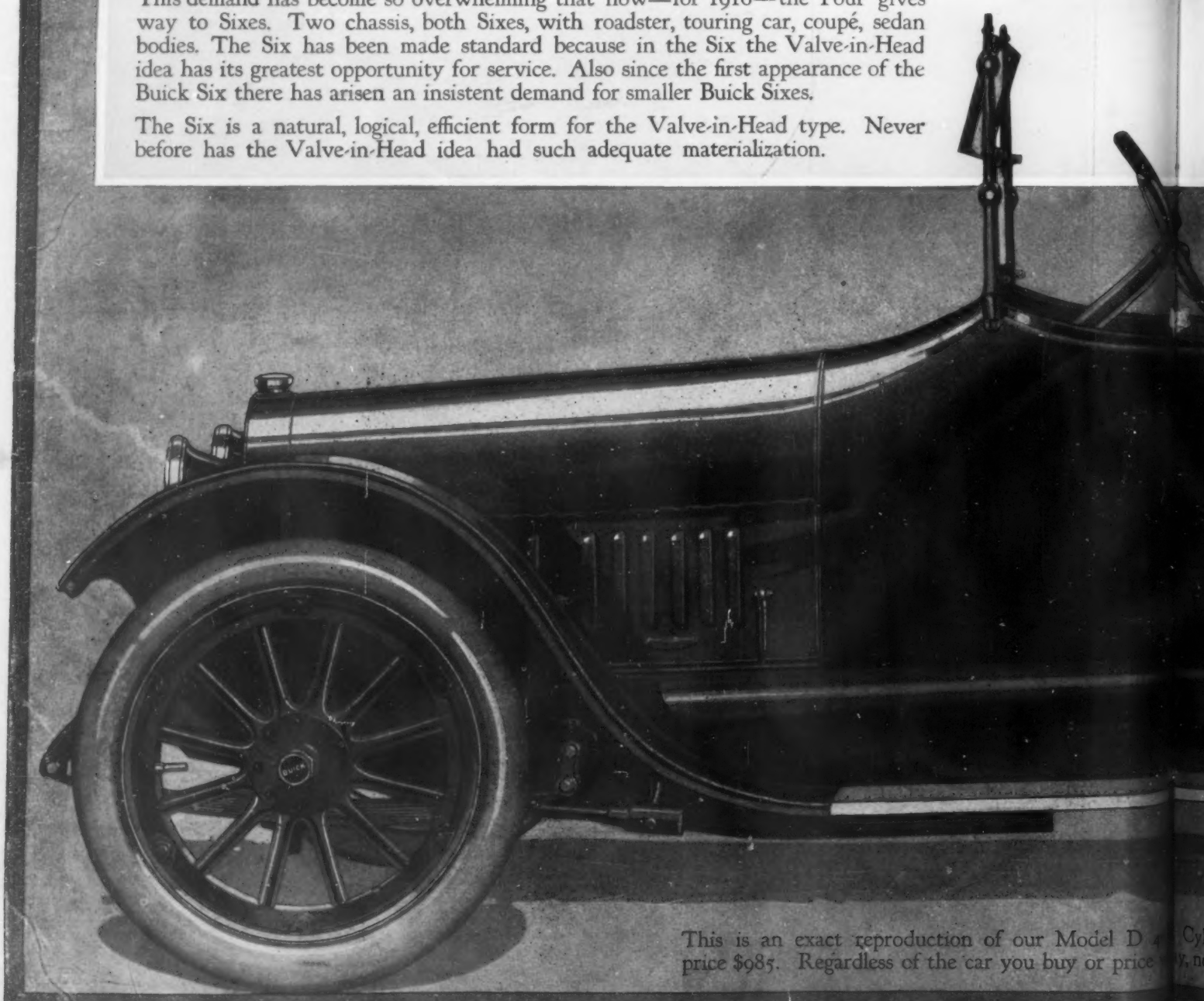

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16
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Buick

PIONEER BUILDERS
OF VALVE-IN-HEAD
MOTOR CARS

This year the Buick factory is arranged for Sixes exclusively. The production will be large. Demand necessitates a steady stream of Buick trains leaving the factory during the season. And the Power, Economy, Dependability and Comfort of 1916 Buick Sixes justify this demand more than ever. Study the specifications and you'll see why.

HORSE POWER—Built regularly in 45 and 55 horse power, SIX-CYLINDER VALVE-IN-HEAD motor with two size chassis. WHEEL BASE—115 and 130 inches. REAR AXLES—Genuine full floating, with spiral bevel gear drive. REAR SPRINGS—Buick special cantilever. BODY—Full stream line exceptionally roomy for both passengers and driver. One-man top with clear vision side curtains, which remain attached and fold neatly in top when not in use. WIND-SHIELD—Two-piece rain vision and ventilating. LEFT HAND DRIVE and center control. Quick demountable rims. UPHOLSTERING—Fine quality, genuine leather, luxuriously trimmed over curled hair and deep coil springs. Handsomely painted and finished. Furnished complete even to the smallest detail.

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Roadsters and Touring Cars, $950 to $1485 · Coupés and Inside Drive Sedans, $1350 to $1875

Catalogue and detailed specifications furnished on request. Samples on exhibition in all principal cities. Deliveries immediately.

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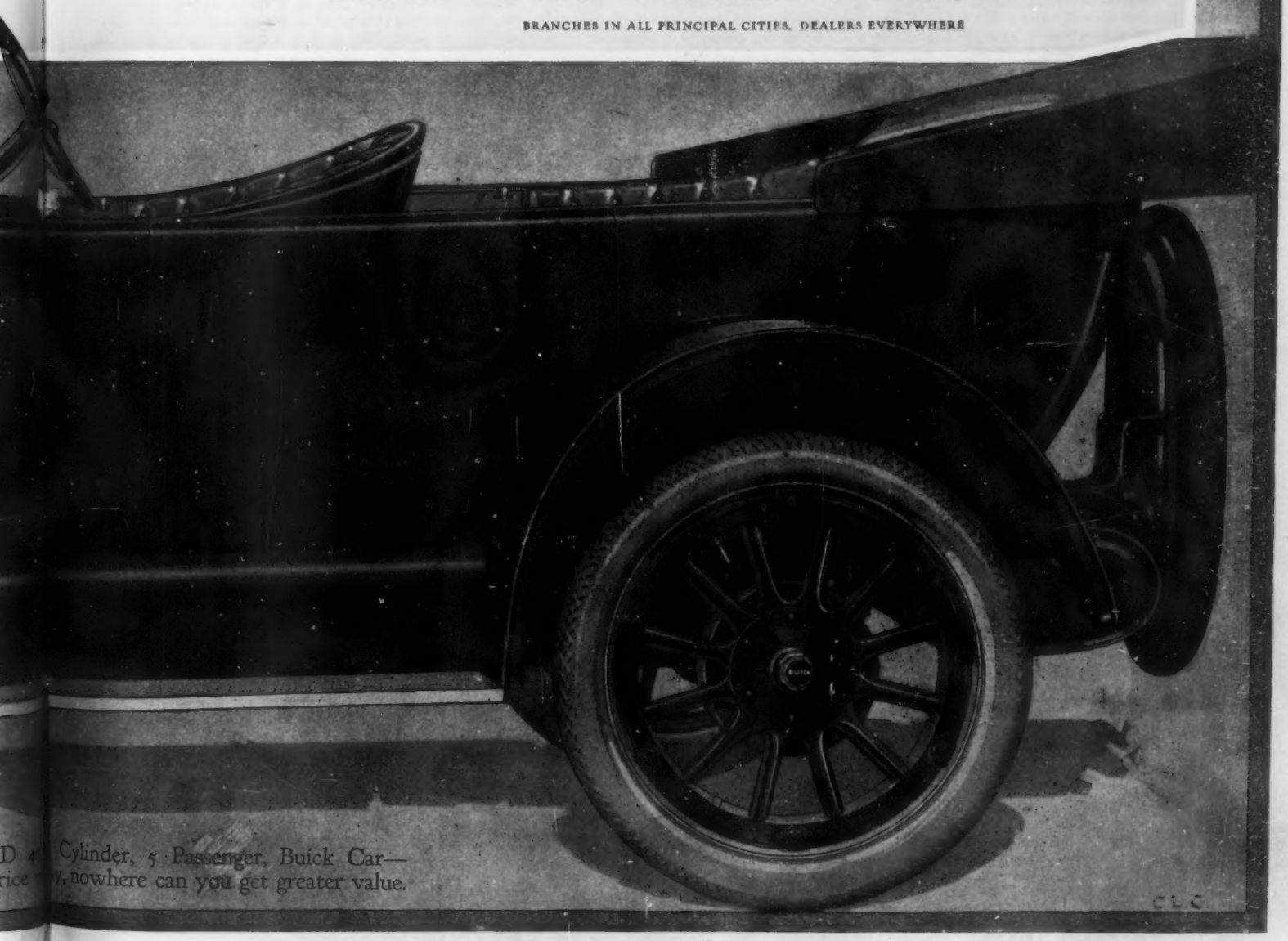

D 4 Cylinder, 5 Passenger, Buick Car—
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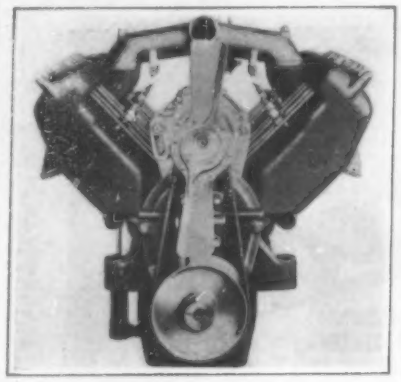
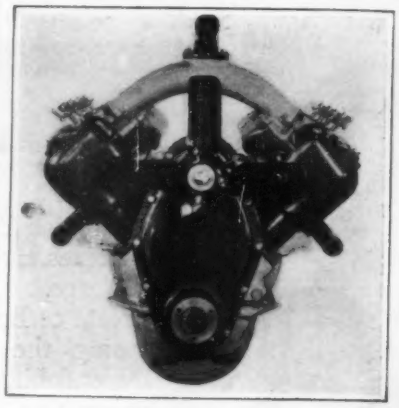


Inclosed overhead valves of the Ferro "Eight," showing exterior push rods operated by a common camshaft.

The How and Why of the V-Type Motor

Efforts to Produce a Steady Stream of Power by the Use of Eight and Twelve Cylinders

By John S. Harwhite



A Buda "Eight," showing the space between the blocs of cylinders reserved for the necessary motor attachments.

A PROMINENT engineer has said that the mere matter of the number of cylinders in an automobile motor is not of primary importance: "The real matter of primary importance is the number of cylinders necessary to produce a car which will perform as its owner wants it to perform." If a single cylinder motor could be designed to give exactly the same results as are obtained from the "Six," there would be no excuse whatsoever for the production of the "Six." It is only because the manufacturers have believed that certain desirable characteristics of performance, not possessed by a "Four," could be obtained from a "Six," that the large majority of cars selling at over $1,200 have been of the six-cylinder rather than the four-cylinder type. If the "Eight" accomplishes these results, there will be no need for the "Twelve;" but if two blocs of six-cylinders each are found to do their work better than the "Eight," the subsequent advent of the twelve-cylinder motor marks another forward stride in modern automobile construction.

As many of the general principles of construction apply both to the V-type "Eight" and the "Twelve," and as the "Eight" was the first of the V-type motors to make its appearance, a description of its leading features will be given first, followed by a discussion of the slight differences to be found between it and the "Twelve."

The ideal engine produces a steady stream of power. This condition is most nearly approached in a gasoline engine by multiplicity of cylinders, and as the automobile engine is of the four-cycle type in which the explosions occur in each cylinder only at alternate revolutions, at least six cylinders are required to obtain an overlapping of power impulses. Six cylinders have always been placed in one continuous line. When we reach the eight-cylinder type of design, however, we find a departure from heretofore accepted practice, for these cylinders are divided into two sections of four each and are placed with their heads side by side and the lower blocs converging to connect with a common crankshaft. Because of the junction of these two separate motors at the lower point, this type of engine has been termed the "V" eight, although the angle is, as a rule, 90 degrees. It will be seen that this type of construction increases the piston displacement of a motor without adding materially to the length of the crankshaft. Two cylinders are enabled to direct their impulses at each throw of the regular four-cylinder crankshaft, and thus, not only is the power increased, but the frequency of impulses is doubled. Such a motor is no higher than a four-cylinder engine developing approximately one half this power, the only increased dimension being the width, which is easily provided for in cars as at present designed.

Naturally the increase in the number of impulses and the absolute overlapping of the power strokes result in a smoothness of operation that has never been reached in the "Four." In this design each explosion is balanced by compression in other pistons, so that not only is a large proportion of the vibration absorbed, but the angle at which the cylinders are set serves to change the direction of the force of these impulses. Consequently, there is no horizontal vibration attendant upon the operation of a well-designed eight-cylinder motor, although it is claimed by six- and twelve-cylinder adherents that these vibrations have been merely changed in direction to those of the horizontal type.

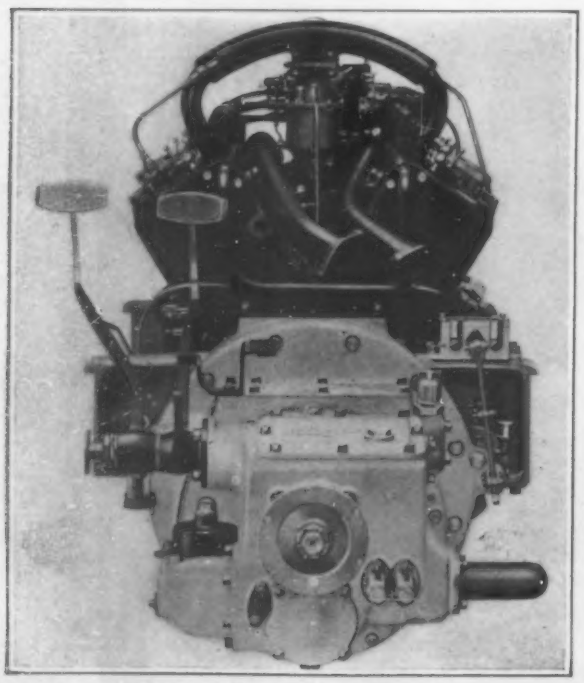
From the manufacturer's standpoint, however, it is probable that one of the principal advantages in the eight-cylinder motor lies in its simplicity of design and low-production cost. It has been estimated that the cost of manufacture of an eight-cylinder motor of a given power is scarcely as great as that of a six-cylinder machine developing the same energy. There are a fewer number of crankshaft bearings in the former, and it has been shown, in some instances, that the saving in weight is also in favor of the "Eight."

There is already a variety of designs of the eight-cylinder motor, and it is rather difficult to select the point at which the main classification of the various types should start. In practically all instances, each of the two sets of four cylinders is cast in a single bloc, and these are in turn bolted to a single crankcase. In at least one instance, however, the two series of four cylinders are cast in a single piece, which also comprises the upper half of the crankcase. This is a type of design which naturally makes for great rigidity of construction, although the problems encountered in the foundry may prove serious to some manufacturers.

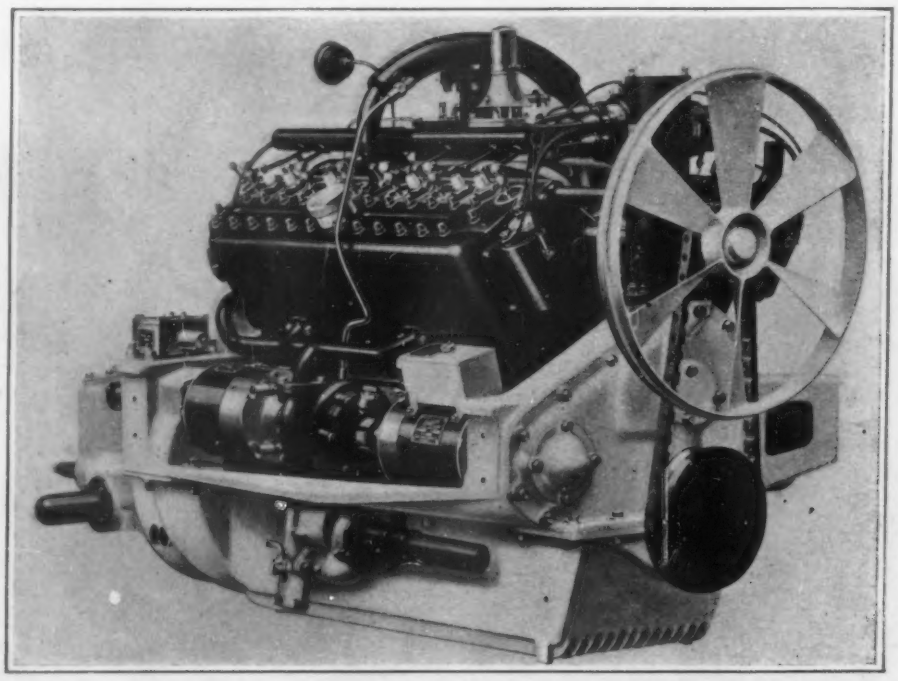
Probably the two great classifications into which eights could be divided are the "opposite" and the "staggered." In the first type each cylinder of one bloc is placed directly opposite the corresponding cylinder in the other bloc. In the second type, one bloc is set a slight distance ahead of the other. In the construction in which the cylinders are set directly opposite each other, the connecting rods of each opposing pair must meet at a common point, which makes necessary a sort of "two-in-one" bearing. One method of combining the bearings of the two connecting rods at a common point is to fashion the end of one in the form of a yoke, which incloses two sides of the other connecting rod bearing. The yoked, or outer rod, holds the bearing rigid, while the plain, or center rod, oscillates on the outside of the bearing. Another interesting method of obtaining the short and compact design, which is a feature of this type of construction, is to attach the opposite rod to the main rod by knuckle joints similar to a wrist pin. Thus, but one connecting rod is attached directly to each crank, although this bearing takes the thrust and resistance from both cylinders of the pair. This method is resorted to in order that the crank pin bushings may be made easily removable.

In the case of the staggered "Eight," each connecting rod bearing is separate. Although those of the two pairs of opposite cylinders are placed side by side, each may be tightened or fitted separately, however, and we really have eight "big end" bearings.

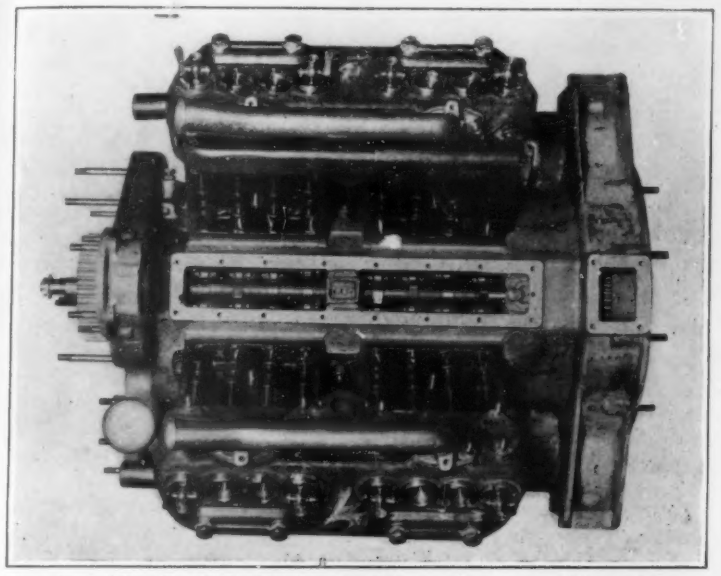
In the majority of eight-cylinder designs the valves are placed on the inside so that they may be operated from a single camshaft located at the lower point of the "V," just above the crankshaft, and driven by the usual form of two-to-one gear or silent chain. This design is easily arranged, inasmuch as the camshaft occupies the point of convergence of the valve stems if the latter were extended to intersect. On some motors, a single cam is used for the operation of opposite valves so that only eight cams are required in all. If the



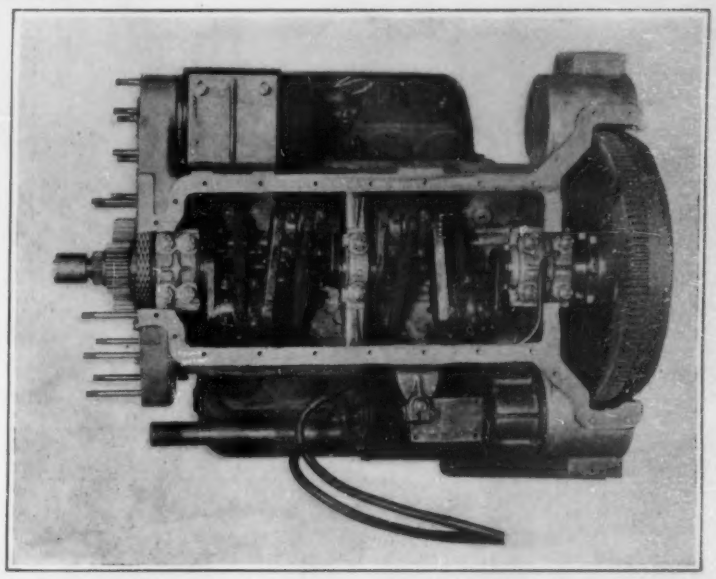
Rear view of the Packard "Twin Six."



The compact arrangement of the Packard twelve-cylinder motor.



Top view of the King "Eight," showing sixteen valves operated by eight cams on a single camshaft.



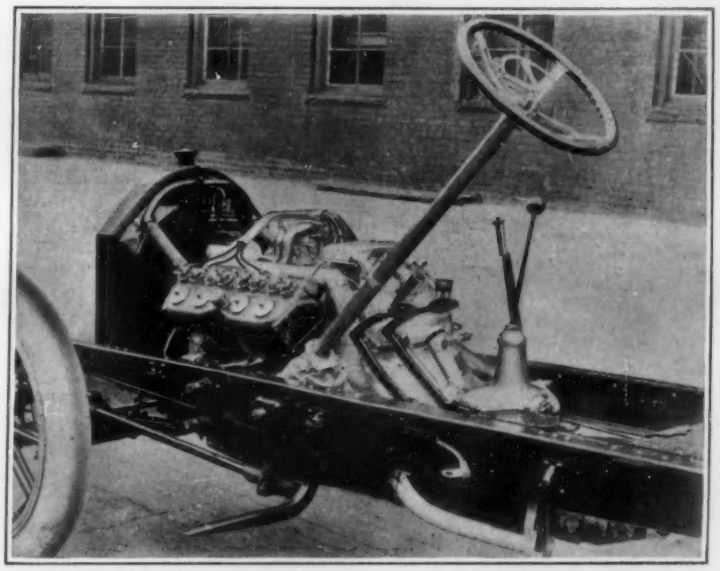
Under view of King, showing yoked connecting rod ends used on many motors in which cylinders are placed opposite one another.

staggered type of construction is used, however, each valve requires its individual cam for its operation, although the entire sixteen are, of course, mounted on the same camshaft.

The space in the angle of the V between the blocs of cylinders lends itself well to the accommodation of the various accessories that now form an important part of automobile engine equipment. Because of their location directly over the crankshaft, the starter, generator and timer may be driven without the necessity of introducing an undue number of gears or chains. The concentration of these fixtures results in a compact power plant and renders the accessories themselves easily accessible. There may be an inclination on the part of some designers, however, to place so many of the accessory outfits in this location that the accessibility of the valve tappets is greatly interfered with. Naturally, the valves of an L-head motor driven by a single camshaft can be reached only from the center of the V. Therefore, rather than relegate some of this necessary motor equipment to inaccessible places on the side or in front of the motor, some designers have proceeded to reverse the bloc castings and thus bring the valves on the outside. This, of course, necessitates the use of two camshafts, but the valve tappets are rendered accessible and all the motor paraphernalia that the "V" will hold may be safely placed between the blocs.

Another type of eight-cylinder design which lends itself especially well to compactness, as well as accessibility, is that in which the valves are placed overhead and are operated by push rods extending from a single camshaft. Such valves are placed in a removable head on each bloc, which facilitates valve grinding without the necessity of disturbing any of the starting, charging, ignition or carburetion systems that may be placed in the "V."

One of the principal problems with which the designer of the eight-cylinder motor has had to contend is that of the proper lubrication of each of the cylinders. The ordinary type of splash feed for the pistons and cylinder walls will hardly serve its purpose in this case, for the bloc first encountered in the upward swing of the crank would be the one to receive nearly all the benefit of the lubrication at the expense of the bloc on the opposite side. In motorcycles this difficulty has been overcome, to a certain extent, by placing a baffle plate at the rear cylinder so that an excess of oil will not reach the piston. Such a proceeding would hardly be satisfactory in the case of a highly-refined eight-cylinder automobile motor, and consequently a positive system of oil feed to each cylinder must be used. There are various methods by which this end is accomplished, but as the "Eight" is of the small cylinder, high-speed type, it is all the more necessary that whatever system is employed should be positive in its action and supply each piston, as well as each bearing, with its share of lubricant.

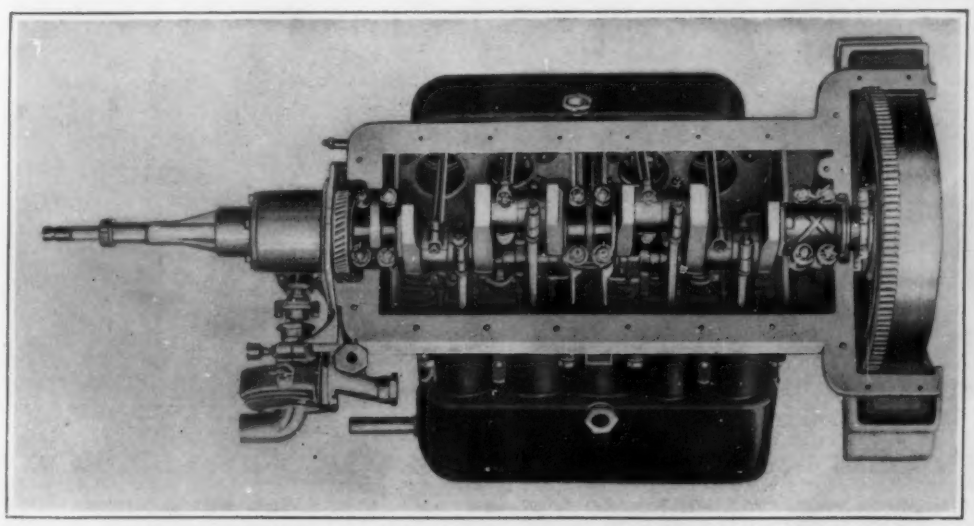


How the Cadillac "Eight" lends itself to accommodation in a short bonnet.

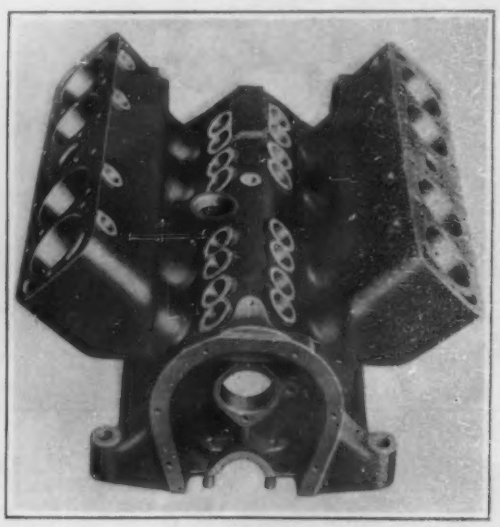
The advent of the eight-cylinder motor in this country has produced several problems for the accessory manufacturer to consider, and, in fact, it is probable that the automobile industry as a whole will be more or less affected. For example, not only are there a greater number of explosions at each revolution of the eight-cylinder motor than is the case with the "Four" or "Six," but it is designed to operate at a higher speed. With one type of eight-cylinder motor speeds of 3,000 revolutions per minute in practice are not unknown, and this means the formation of 12,000 distinct sparks in sixty seconds. This has resulted in the refinement of ignition apparatus, until now an eight-cylinder motor may be fired as accurately as was the case with a "Four" a few years ago.

As the "Eight" uses a standard shape of four-cylinder crankshaft, so does the "Twelve" or "Twin Six" employ the familiar type of six-cylinder crankshaft with its crank set at an angle of 60 degrees. This difference in crank angle, however, makes it advisable to set the opposite blocs of cylinders at an angle of 60 degrees, instead of the 90-degree angle usually found in the "Eight." The "Twelve" is thus inherently a narrower motor than is the "Eight," and this feature presents several interesting points in its favor. The sharper angle between the blocs permits the motor accessories to be placed in convenient positions along the *outside* of either bloc and thus leaves the inner space free from the examination, adjustments and grinding of the valves. Furthermore, the narrower motor permits of the use of a more accessible steering gear and allows the frame to be narrowed so that the radius required for turning is reduced by a

(*Concluded on page 29.*)



Under view of the Herschel-Spillman motor, showing the staggered arrangement of connecting rods.



Casting for a Ferro "Eight," including cylinder valves and upper part of crankcase.

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Resighting captured Austrian rifles in Serbia.

Germans examining the bombs of a captured British aeroplane.

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Thrown into the air by the recoil.

Examining an unexploded French bomb.

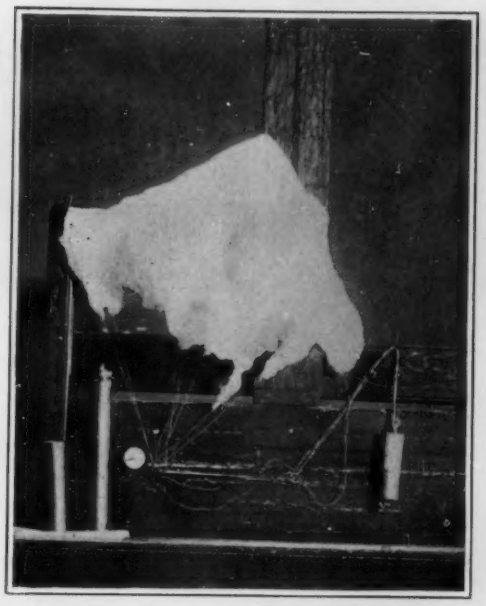
New French "lance-bomb."

The Kaiser and his military staff.

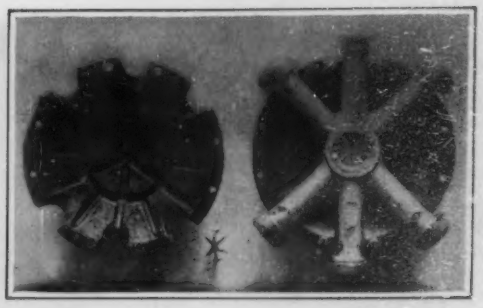
The Kaiser, in center. Left to right: Seated—Crown Prince Ruprecht von Bayern, Duke Albrecht von Würtemberg, Colonel General von Kluck, General von Emmich, General Field Marshal Count von Haester, General Field Marshal von Hindenburg, Grand Admiral von Tirpitz. Standing—General Field Marshal von Bülow, General von Mackensen, Chief of General Staff von Moltke, Crown Prince Friedrich Wilhelm, Infantry General von Francois, Chief of General Staff von Ludendorff, Chief of General Staff von Falkenhayn, General von Einem, General von Beseler, Imperial Chancellor von Bethmann-Hollweg, Colonel General von Heering.

PHOTOGRAPHS FROM WAR-TORN EUROPE

German army officers taking observations.

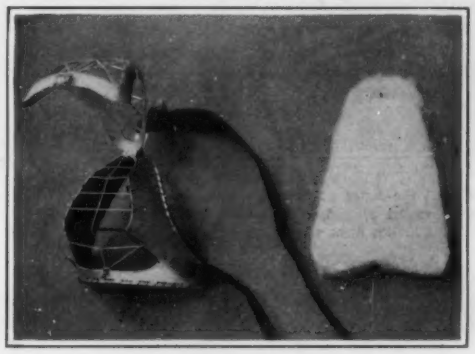


Parachute candles used by Zeppelins in night attacks.



German bomb with radiating cartridges.

French soldier protected against poisonous gas.



Constructional details of the gas mask.

Hand grenades captured in eastern Prussia.

British naval gun doing service in Serbia.

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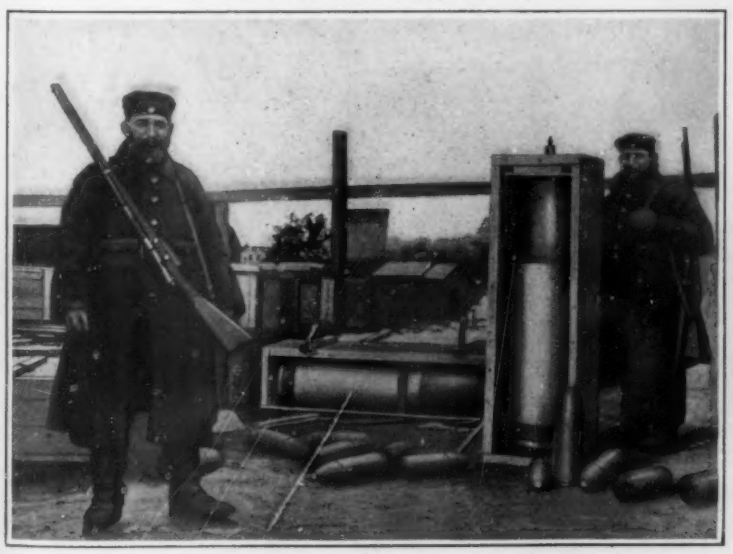
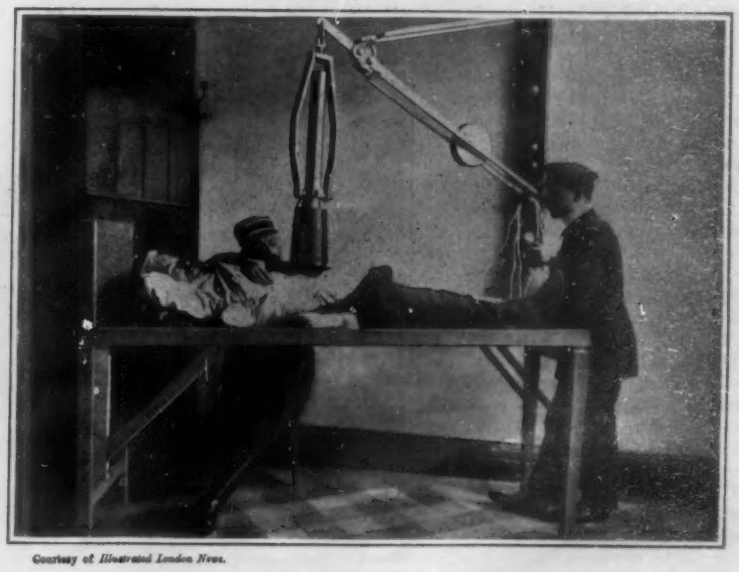
A well-concealed gun in Serbia.



Shells left behind by the Russians in East Prussia.



Courtesy of *Illustrated London News*.

Extracting a shell splinter with an electromagnet.

PHOTOGRAPHS FROM WAR-TORN EUROPE

How Rifle Bullets Fly

French and Swiss Bullets of Stream-Line Shape to Reduce Air Resistance

By Edward C. Crossman

WHEN the powder charge of a military rifle like the German Mauser is ignited, it drives from the muzzle of the rifle a little 30-caliber, 150-grain bullet at the rate of practically 3,000 feet per second. This does not mean that it flies the first 3,000 feet in one second, because the instant it is clear of the terrific blast of powder gases that follow it, it commences to fight the resistance of the air just as a steamer fights the resistance of the water through which she ploughs.

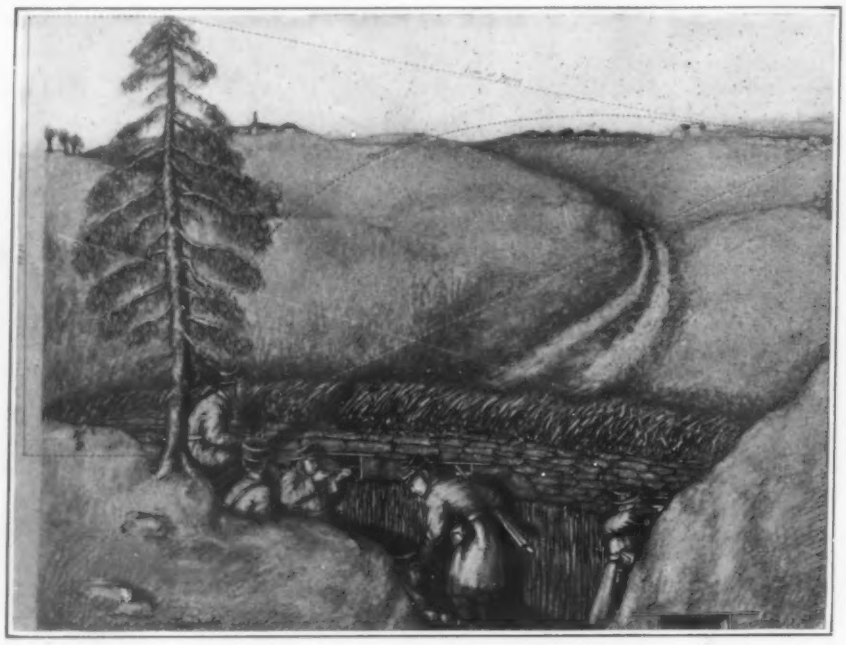
Our bullet gets down the first three or four hundred yards with the average speed of 2,500 feet per second, or at the rate of 1,700 miles an hour. A steamer travels little more than 20 miles per hour, even though she be of the Atlantic greyhound type. So the bullet is experiencing the same pressure from the air as if it were standing still and had a gale of 1,700 miles an hour blowing against it. A gale of 140 miles an hour, one twelfth of this 1,700-mile rate, will blow down buildings.

So, while the air is considerably less dense than water, the speed of the rifle bullet is so terrific that its ability to slip through the air is just as important as is the ability of the boat to slip through the water. The two differ in this—that while the steamer and the sailing vessel have their propelling power always working within or against the sails of the boat, and so propelling it at a uniform rate, the bullet has its impulse all given at the very start, and no further help along its course can be handed it. It is like a ship that is sent plunging down a very long and steep set of ways into the water. The moment the momentum received from the slide is lost through the resistance of the water, the ship stops.

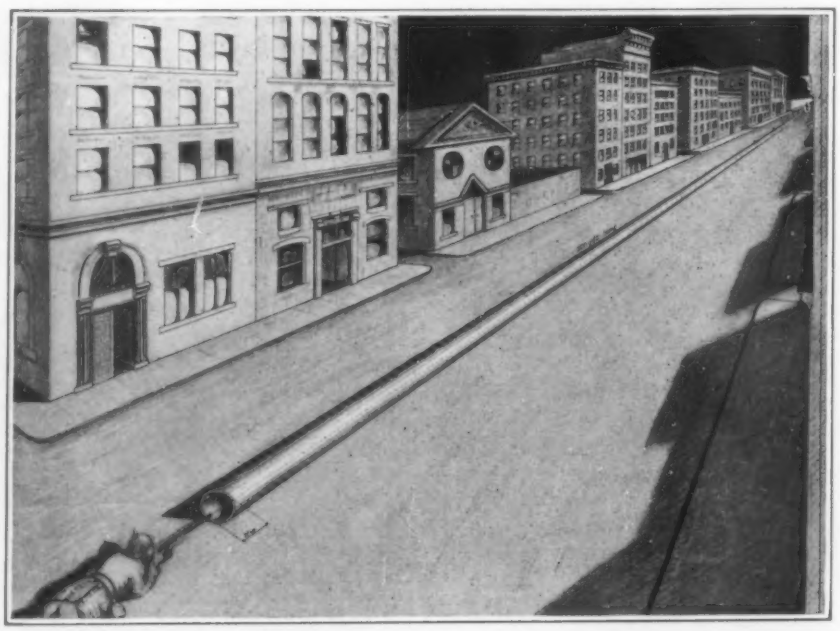
So important is this air resistance to the flight of the bullet, and so well is it understood in these modern days, that modern bullets have long sharp points like well-sharpened lead pencils to overcome this resistance from the comparatively dense medium—the air. No bicycle rider needs to be told how much this enters into even the progress of low speed objects. Drop the wind shield on a motorcar traveling 30 miles an hour, and without touching throttle or spark the car travels 34 or 35 miles an hour instead of 30. Make this speed 1,700 miles an hour, and although our bullet is a tiny, heavy object with but a third of an inch diameter to offer to the air, the slightest change in its form means a huge change.

But for this resistance of the air we would have only the problem of gravity to consider. The instant the bullet departs from the bore of the rifle it becomes liable to the laws of gravity, just as much as the apple that fell from the boughs of the tree before the eyes of the suddenly enlightened scientist.

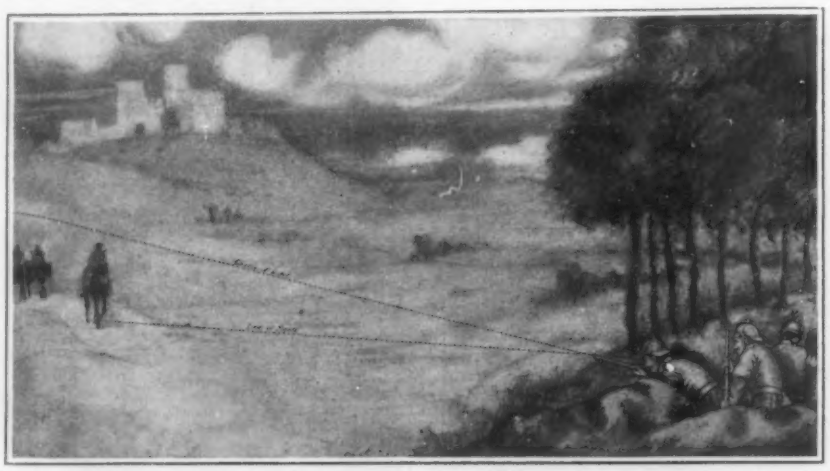
If, as has to be the case, the bullet is projected out on a line rising above the horizontal or a straight line to the mark, then it commences to fall from its projected line at the rate of 16 feet the first second of its travel, 48 feet the next second, and so on, with the rate of fall constantly increasing. The speed of the bullet does not alter this fact; it merely gets the bullet to the mark before much time has elapsed, and therefore before it has fallen far from its projected line of flight.



To land in these trenches at the range of 1,000 yards, the German Mauser is actually pointed at the top of the tree, 40 feet above the ground, although the sights are aligned on the trenches. The 0.45-0.70 Springfield of Indian fighting days would have to be pointed 175 feet above the line of trenches to reach them.



Germany drives its bullet a distance equal to five city blocks, or 500 yards, without the line of flight being high enough to touch the top of a 20-inch pipe. Its trajectory is "flat."



If the German rifle is sighted for 1,000 yards, and aimed even clear down at the feet of the horse of a cavalryman, the bullet will go clear over his head if he is anywhere from 300 to 800 yards away from the rifle. In spite of its high velocity, the trajectory or flight of the bullet is no longer flat. It rises only 20 inches in flying 500 yards; it rises 13 feet in traveling 1,000 yards. The answer is chiefly air resistance.

Were it not for our air resistance, hitting objects a distance from the rifle would be simple, and we could adjust our rifle sights merely to overcome gravity according to the formulæ used for the fall of objects in *vacuo*. If our rifle had a muzzle velocity of 2,700 feet per second and our mark stood 2,700 feet away, then our bullet would take just one second to get out here. As our bullet would fall just 16 feet in this second, we would have to aim our rifle just 16 feet higher than our mark, so the falling bullet would strike it after coming back to the line of the sight to the mark. And so our bullet, projected out on a line with a spot 16 feet above our mark, would gradually fall away from this line under the pull of gravity until at the mark, one second's time from the muzzle, it would have returned again to the line of sight and would hit the mark.

This is the principle of sighting a rifle—to actually point the muzzle at a spot as much higher than the mark as our bullet will fall in the time it takes to pass over the distance. By the use of an elevating rear sight we are enabled to do this and still aim the sights themselves at the mark. Here, of course, the line of the sights and the line of the barrel do not coincide, the sights pointing at the mark, the barrel pointing far higher. But, while the rifle has to be pointed as much higher than the mark as the bullet will fall in the time it takes to travel the distance, we cannot figure the time taken by any such simple means as taking for granted the fact that the bullet flies over the distance with all its muzzle velocity. It does not, and our friend the air is behind the trouble.

A bullet with the muzzle speed of 2,700 feet per second does not travel 2,700 feet down the range in one second. A bullet with the sharp needle point of the U. S. Army bullet or of the German Mauser bullet, with this 2,700 feet per second muzzle velocity, requires 1.6 seconds—practically 1⅔ seconds—to cover the first 2,700 feet. The extra two thirds second is due to head resistance. Instead of arriving at the mark 2,700 feet away with all its original speed left, our bullet arrives with just 1,140 feet per second speed left. That is, its speed when it reaches the mark, if retained from then on, would take it over 1,140 feet in one second. Of course, it is not retained, but continues to drop. Hence, instead of so adjusting our sights as to make the line of

(*Concluded on page 29.*)

Distribution of parcel post among the German soldiers in Eastern Prussia.

The German Post Office and the German Army

The Working Scheme of the Field Post Had Long Been Prepared in Time of Peace

By Dr. Alfred Gradenwitz

ON the roads and railways connecting the theater of war with the countries of the belligerents there is an endless going and coming of trains and columns, constituting a permanent communication between the armies and their natural bases: Fresh troops, intended to reinforce those in the field, ammunition and victuals, trains of wounded removed from the fighting line, and last, but not least, the Field Post, which throughout the changing situations of warfare, forced marches as well as actual battle, maintains a connection between those fighting for their country and their dear ones at home.

Just think what it means to those separated from their families for nobody knows how long—perhaps forever—to have means of communicating with them, to send them their greetings, to inform them of their health and their doings, and to receive their own tokens of love, be assured that all are well at home and thus be kept in good spirits. This is why the German Field Post carries free of charge any ordinary post card or letter to or from soldiers, while those exceeding a certain weight (50 grammes), postal money orders, etc., are charged for at greatly reduced rates. But how can the working of this Post be maintained under the enormous difficulties of modern warfare?

The working scheme of the Field Post had long been prepared in time of peace and the German post offices were acquainted with its very details, so that, when the war broke out, any undue delay could be avoided. Still, there were enormous difficulties to be overcome in the first weeks: The ordinary schedule being discontinued shortly after the proclamation of mobilization, there was, throughout the German railroad system, an endless succession of slow trains crossing the country in all directions, stopping at each station to pick up those called to the colors. On these trains the mail service of the country had to rely for some weeks, and as, apart from their sickening slowness, they were only few in number, postal conditions were temporarily brought back to what they might have been about the middle of last century. It is under such difficult conditions that the Field Post had to commence operations.

The main feature of a military or "field" letter is its bearing the designation of the army detachment the addressee belongs to in place of the destination, at least in the case of the mobile troops. Before beginning operations, the Postal Department had, accordingly, to be informed of the organization and arrangement of the army. A printed guide—sixty pages folio—was published about a fortnight after the beginning of hostilities and was followed up at intervals of three to four days by new editions growing rapidly to about four times the initial size.

Distributing mail in Eastern Prussia. A church used as a temporary post office.

German field post letter box in the eastern theater of war.

When it is considered that the number of letters and post cards daily conveyed to the German army has grown to the enormous average of eight millions, while those reaching the country from the front total nearly half this figure, it will be understood that the sorting and handling of this mammoth mail involves an unprecedented task. The sorting of the mail is done at twenty-three Mail Collecting Offices installed at the main industrial centers of the country, to which it is referred by the post offices of their districts. This decentralization has been found to be an important factor in saving time. After a number of successive operations the mail matter has at last been sorted, not only according to army corps, divisions and regiments, but according to battalions (batteries, squadrons, or columns), the respective packages being put in the mail bags in which they are to start for their long and perilous journey.

From the Collecting Offices, the mail bags containing the sorted letters, post cards, postal money orders, etc., are at first directed to what are termed Guiding Stations close to the frontier, near the starting points of the communication lines. The domain proper of the Field Post reaches from these points to the mobile Field Post Stations, where all the means of communication—railways, roads, telegraphs and telephones—are at its disposal, insofar as they are not taken up for urgent military purposes.

Since any breakdown, on account of the great length of the communication lines, would be likely to result in a most annoying disturbance of the whole service, relay

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The Machinery of Modern Submarines

Various Motor Types

By A. P. Chalkley

Fig. 1.—Augsburg four-cycle, 800 horse-power engine. Used in later German submarines.

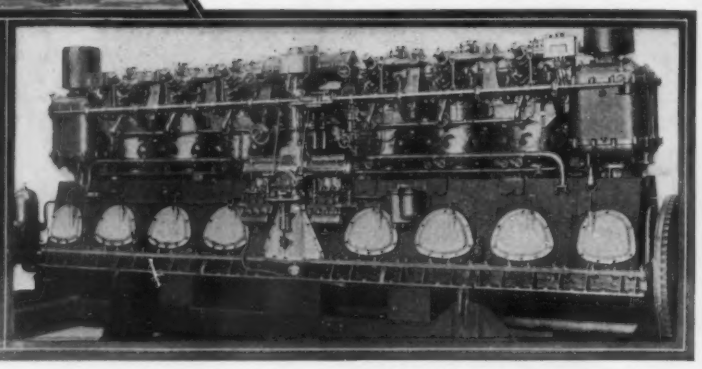

Fig. 2.—Krupp Diesel two-cycle engines; 900 horse-power; used by Germany.

IT is only during the past four or five years that the submarine has become an effective instrument of warfare, and the fact that it has been able to develop in this way from the small low speed craft, suitable only for coastal defense work, is due almost entirely to the progress that has been made in recent times with the Diesel oil engine. One or two of the large modern boats have been equipped with steam engines or steam turbines for propulsion on the surface, but this feature is confined mainly to French submarines, and has never been adopted by the British or German authorities, at any rate for those craft that have as yet been put into service.

The advantages of the Diesel engine, which have thus enabled the submarine to become an important factor in modern warfare, and perhaps to disprove many of the preconceived ideas of naval strategy, are two-fold. A submarine to be capable of taking the offensive must be able to remain at sea for several days on end, and thus be a thoroughly seaworthy craft; it must have a fair speed—certainly not under 15 knots; and it should have a wide radius of action, preferably not less than about 3,000 sea miles. These conditions can obviously only be complied with by an under-water craft in which the mechanical power installed is very considerable and in which the engines operate with an unusually low consumption of fuel. The gasoline engine did not allow of this, for in the first place it is scarcely feasible to construct a type suitable for submarines with more than 400 horse-power, which would not give a total of over 800 horse-power in a twin-screw submarine. This was only sufficient for a relatively small craft, which, while having its utility for a coast defense, was of very little practical value at sea. Again, the consumption of gasoline engines is known to be high, and is nearly double that of the modern economical Diesel engines, while the latter consume fuel that is extremely cheap compared with gasoline.

The chief point of difference between the Diesel and the gasoline engine is that whereas in the latter type a mixture of air and gasoline is drawn into the cylinder compressed by the piston and artificially fired by electric ignition, in the Diesel engine pure air is admitted to the cylinder and compressed to a very high pressure, after which fuel is injected into the combustion chamber and ignites automatically owing to the high temperature to which the air has been raised by compression. Apart from the fact that this principle of operation is much more efficient than that on which the ordinary gasoline type of motor works, it enables a much heavier and cheaper fuel to be employed.

Dealing first with the German under-water craft of the latest type, which have a submerged displacement of about 900 tons (810 tons on the surface), and are designed for a speed on the surface of about 17 knots, the surface propelling machinery in all cases consists of two Diesel engines, each developing about 900 to 950 brake horse-power. Some years ago when the German naval authorities recognized the importance of the submarine and its dependence upon the development of the Diesel engine, arrangements were made with the two important German manufacturing firms, Krupps of Kiel and the M. A. N. of Nuremberg and Augsburg, to develop a type of engine suitable for the craft they had in mind. A large amount of experimental work was carried out by both firms, and about 1911 the motors had reached a thoroughly practical stage, so that from that time on these engines have been built as standards in very large numbers, not only for the German navy, but also for Russian, Italian, Norwegian, Danish, and Dutch submarines.

It will readily be understood that the designing and construction of Diesel engines for the propulsion of submarines are no simple matters. In the first place, the engines must turn over at high speed, since they must be small, for space is limited, and their weight must be kept down to a minimum. While there is no particular difficulty in building slow-speed Diesel engines, the necessity for high speed introduces many difficulties, particularly that of cooling the pistons, cylinders and other parts of the engine, and this explains the long delays that were experienced in all countries before the first Diesel-engined craft was actually put into commission. In certain cases it was as long as four years after they were first designed.

The engine which Krupps have standardized, and which has been largely employed in the later German submarines, is illustrated in Fig. 2. It works on the two-cycle principle, which implies that there is one working stroke per cylinder for every revolution and involves the introduction of scavenging air pumps for supplying air for the working strokes and driving out the exhaust gases after combustion and expansion. In Diesel engines high pressure air compressors are also required to supply compressed air at about 750 to 1,000 pounds per square inch, for injecting the fuel into the working cylinders after compression. In the engine illustrated it will be seen that there are six working cylinders, and at each end is a scavenging pump, while two high-pressure air compressors are placed in the middle. The engine thus consists virtually of ten cylinders. It has a speed of revolution of 400 per minute and develops from 900 to 950 brake horse-power normally.

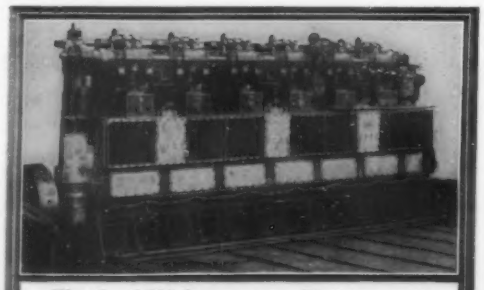

Fig. 3.—1,300 horse-power Fiat two-cycle motor.

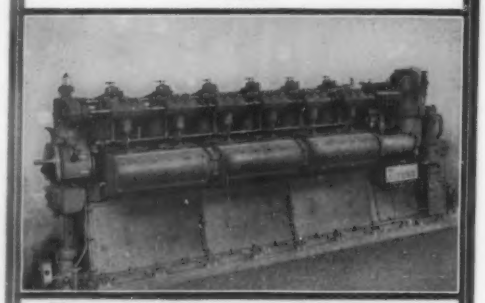

Fig. 4.—Sulzer two-cycle, 600 horse-power engine. Used by America and Japan.

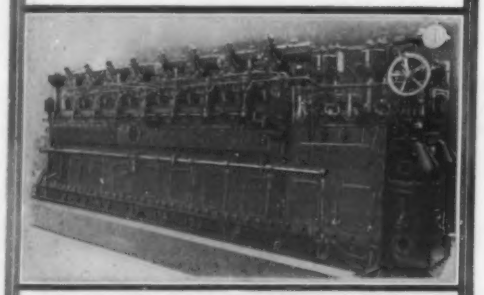

Fig. 5.—900 horse-power Nuremberg two-cycle submarine motor.

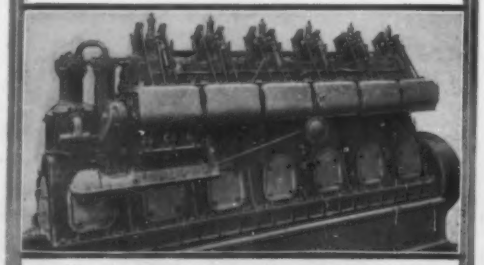

Fig. 6.—Polar four-cycle motor used by Swedish navy.

Like all Diesel motors, this engine can be started up immediately by means of compressed air, and is moreover directly reversible, unlike most of the machines employed in the British submarines. This operation is carried out by moving the camshaft so that a second set of cams comes into action and changes the timing of the valves for running in the opposite direction. For the sake of lightness manganese bronze plays an important part in the construction of these engines, the bedplate and crankchamber being built of this material. By this means the weight of the engine is kept down to about twenty tons, which is, of course, a low figure for a Diesel motor.

The M. A. N. build two types of Diesel engines, both of which are used in modern German submarines, one, constructed at Nuremberg, working on the two-cycle principle, while the other, built at Augsburg, is a four-cycle machine. The first is illustrated in Fig. 5 and has eight working cylinders 310 millimeters in diameter and 340 millimeters stroke. There are two separate air compressors, seen on the right of the illustration, for the supply of injection air, while the scavenging pumps are placed immediately beneath the working cylinders and cannot therefore be seen. The designed output is 900 brake horse-power at about 400 to 450 revolutions per minute, although it is stated that on test 1,000 horse-power can be developed for long periods. This type of engine is also directly reversible (the operating being rendered possible by giving a rotary motion to the camshaft instead of sliding it as in the previous instance), but it will be noticed that the control is at one end instead of being in the center, as with the Krupp engine. The overall length is about 23 feet and the height about 8 feet 6 inches.

The Augsburg four-cycle engine illustrated in Fig. 1 is built in six and eight cylinder models and the motor shown develops about 800 to 850 brake horse-power at the same speed of revolution, namely, about 400 revolutions per minute. It has only one air compressor, this being seen on the right, while the scavenging pumps are, of course, unnecessary with the four-cycle type. The controlling wheel for starting, maneuvering, and reversing the engine is again at the end, while another point of similarity, to be seen in most high-speed submarine Diesel engines, is the manner in which the valves in the cylinder head are inclined, and not vertical as is the case in slow-speed Diesel motors used for ordinary mercantile work.

Most of the Diesel engines for installation in British submarines have been built by the well-known Vickers firm and are of the four-cycle type; those employed in the later design of submarine (of the "E" class) developing 800 to 850 brake horse-power in eight cylinders. It is of special interest, in view of what has been said before, that these machines operate on the four-cycle principle and are non-reversible, reversal being carried out by means of the electric motors employed for under-water propulsion. The chief peculiarity of their construction is that compressed air is not used for injecting

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The Strategic Moves of the War

By Our Military Expert—June 23rd, 1915

THE week ending June 23rd was marked by hard fighting in every theater of the war. The assaults of the French and English on the German western line were made with a determination that has not characterized their cautious "nibbles" of the past months. The Italians have met steadily increasing opposition from the Austrians, but their systematic advance has not been stopped. The fighting on the Gallipoli Peninsula between the Allies and the Turks may not have had a very conspicuous place in the daily reports, but this is due mainly to the comparative weakness of the forces engaged. And in the eastern theater the combined German and Austrian armies have exceeded all past performances in ferocious fighting in their supreme endeavor to wreck the Russian army before it can recover from its recent defeats. Altogether, the events indicate that we are about to witness the first decisive climax of the war—a climax that has been forced by the Germans through their more perfect preparation for the titanic struggle.

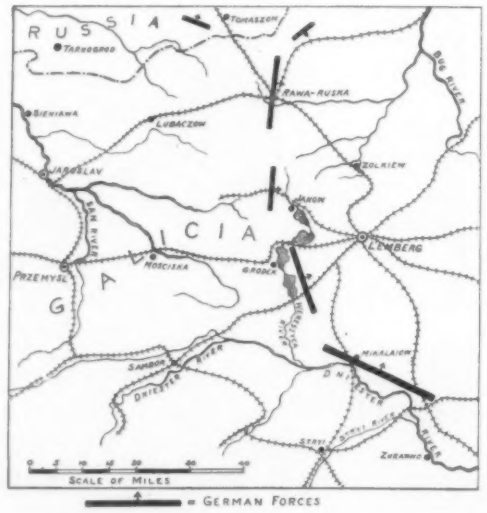
A week ago (June 16th) the allied Teutons were giving the first indications of having recovered from the ravages, exhaustion and disorganization of their long sustained drive through Galicia which culminated, a month after it began, with the capture of Przemysl June 3rd. With their armies reinforced and resupplied in a remarkably short period they resumed their hammering at the line to which the defeated Russian army had withdrawn, extending for some three hundred miles along the San and Dniester rivers. Mosciska and Grodek, between Przemysl and Lemberg, fell in rapid succession, and the center of the Russian line being thus bent-in, their right and left wings had to be drawn back to the new alinement. This brought the Russians to their last defensive position west of Lemberg, and this is already crumbling under the terrific fire of German artillery and assaults of German infantry. Before these notes are in print another phase of this eventful campaign most probably will have been completed with the capture of Lemberg, and a still more decisive phase will have been begun.

The resistance of the Russian armies has grown much weaker during the week under consideration and they are not displaying anything like the ability quickly to recover from a serious reverse which they manifested earlier in the war. There is no longer any doubt but that this is due largely to lack of guns and ammunition, a deficiency that numbers, courage and leadership however superior they may be, cannot possibly repair. We have no way of knowing just how serious this shortage is, but are told that vast quantities of ammunition are being rushed across Siberia from Japan. It is a long way from Vladivostok to Galicia, and if Russia must await the arrival of these shipments before replenishing her magazines, the campaign most probably will end at whatever time Germany may see fit to terminate it in order to strike elsewhere. On the other hand, there appears to be no limit to the German supplies of ammunition and guns or to their ability to get them to the front in quantities sufficient to replace the daily enormous expenditures of all caliber guns that are dropping a storm of shot and shell on hundreds of miles of Russian trenches. The whole situation furnishes the far-famed German organization, industrial, civil and military, with a supreme opportunity—an opportunity that will not be lost.

The conduct of the Russian retreat under the conditions described in the reports that reach us through the press has been to date an example of courage as inspiring as any similar operation in the annals of war. There comes a time in a long, nerve-racking retreat, marked by one disaster after another, when man's will to resist is so greatly weakened that whole organizations will throw down their arms even when they have their belts full of ammunition; yet these Russian armies have apparently been going through just such a trying experience, but without ammunition, and with bayonet and clubbed gun have stubbornly withdrawn from one position to another, and have made the Germans pay dearly for every victory they have won. Whatever we may say of Russian leadership when we know all the facts, there seems to be no doubt about the fighting qualities of the Russian soldier as measured by his ability to take punishment like a stoic.

The moves by which the Germans advanced from Przemysl to Lemberg were planned to win even though stronger resistance had been met. After the capture of Przemysl, the Russian right wing was protected by the San River and the left wing by the Dniester, but the center had been pushed back to Mosciska. To have forced the crossings of the San and Dniester in the face of the Russian armies would have been a difficult and expensive operation, as the Germans discovered when they made their first serious effort to cross the wide Dniester and still wider marshes that extend along its banks, and were thrown back with serious losses. But a successful attack against the Russian center at Mosciska and to the north would compel the Russian line still farther north on the San to withdraw or be in serious danger of being isolated. This attack was successfully carried out and the retreat of the Russian center from Mosciska to Grodek carried with it the Russian right wing, which was closely followed by the pursuing Germans. The attack at Grodek and to the north a day or so later pushed the Russian right and center back still farther and the left wing, to save itself, began to withdraw from the Dniester, closely followed by the Austrians. The Germans pushed their advantage, and with the capture of Grodek and line of lakes in the center, and Rawa Ruska on the Russian line of communications from Lemberg to the north, the recapture of the Galician capital appears to be but a few days off.

Lemberg is the last place of any importance that the Russians can try to hold in Galicia, and with this city in the possession of the Teutons the further task of clearing Austrian territory of the Czar's forces should be comparatively easy. But this alone would be far from a decisive ending of a campaign that has demanded the combined efforts of the Austro-German armies over a period of practically two months, accompanied by an enormous expenditure of war supplies and loss of life. The story of it might make many pages of history that future generations of Teutons could point to with pride, but if it is to have a decisive effect on the outcome of the war, if it is to bring the allied Germans materially nearer to ultimate victory, it must



Teutonic armies closing in on Lemberg.

accomplish a much greater result than the mere driving of the Russian from territory he had conquered in his victorious advance. Nor will the decisive result be secured by pursuing the beaten Russian armies into the vastness of Russia, for the Germans cannot win this war by merely over-running the territory of Russia—their aim is to destroy the Russian armies.

What appeared to be little more than the aspiration of German ambition a few weeks ago looks like a possibility to-day. One of her most trusted and able commanders, Gen. von Mackensen, is in command of the army that has taken Rawa Ruska and reached a position where he may pierce the Russian line, swing to the southeast and effectually separate the Russian armies. This is a favorite play of German strategy, used most effectively on the French in 1870, when two great French armies were surrounded in succession, one at Metz and the other at Sedan. Should a similar strategic move be made and succeed against the Russian forces in this theater, the southern wing of the severed army might be driven toward Odessa and in all probability would be captured or dispersed. With this large fraction of the Russian army disposed of the further task of the Germans in Russia would be comparatively simple.

That the Russians fully appreciate this aim of German strategy and the danger it involves for the Russian army has been made clearly evident by the nature of the Russian retreat throughout the entire campaign. In the absence of sufficient strength and war supplies to fight a decisive battle with fair prospect of victory, the only way left the Russian commander to defeat the German plan to force a pitched battle is to withdraw steadily from position to position, under conditions which will inflict the greatest possible loss on the Germans with comparatively small losses to the Russians. The reports indicate that he has been doing this, for barring the initial disastrous defeat his army suffered early in May at the start of the German drive, he has avoided serious combat with the pursuing Germans while inflicting disproportionate losses on them. With all Russia behind him to withdraw into he may lead the Germans on indefinitely until such time as the strength and supplies of his armies have been restored sufficiently to enable him to take the offensive. A long continued retreat of this character doubtless would have a most disheartening effect not only on the Russian army, but on the Russian people as well, and would call for leadership of the highest order; but it is difficult to see how the Russian army can be saved in any other way if it is as badly in need of ammunition as reports indicate. In the opening days of the war the French saved their army by a similar maneuver, by withdrawing day after day before the Germans advancing through Belgium. Gen. Joffre did not even hesitate to endanger Paris rather than to give battle before he was prepared, and under conditions which might have meant the destruction of his army. It remains to be seen whether the determination of the French commander and the confidence of the French people in his wisdom are to be duplicated in Russia.

It appears that Russia in the hour of her supreme trial cannot hope for material assistance from the activity of the Allies in the western and southern theaters of the war. The French and English have been assaulting the Germans in France with a determination that seems to indicate a purpose to break the German line, and the Italians have steadily increased their pressure on their eastern battlefront. But neither effort has weakened the Teuton forces in the east below what they should be to continue the Russian campaign. Germany and Austria, no doubt, counted on this and provided sufficient forces to take care of their defensive campaign against the French, English and Italians before beginning their offensive campaign against the Russians. The final result of the campaign depends mainly upon the willingness of the Russians to refuse battle and their ability to keep their armies intact. If they fail to do the latter the events of the next few weeks may be decisive for the whole period of the war.

The Story of the Census

UNDER this title the U. S. Census Bureau has recently published, for free distribution, an interesting little pamphlet containing a history of the census from 1790 to 1915, illustrated with numerous pictures and diagrams. During the period in question the census grew from "little more than a mere count of the population to the many, varied, and complex lines of investigation now conducted by a great statistical laboratory organized on a permanent basis." The magnitude of this branch of the Government, as now constituted, can perhaps be gaged by the fact that its total expenses during a decade, including the decennial census, amounts to about $30,000,000. In other words, Americans pay about 3 cents per capita per annum for the luxury not only of being counted, but of having a most elaborate, progressive analysis made of all their activities. The machinery of the census has reached a high state of perfection—if not actual infallibility, the fault lies with the human factor. Thus, there is still some "padding" of census returns; not only for the personal benefit of enumerators, but also on account of the burning desire of cities and towns to inflate their population figures. After the census of 1910, sixty-nine indictments were brought against enumerators and others believed to be responsible for the falsity of returns in fourteen cities and towns, and there were fifty-three convictions.

Compulsory License Under German Patents in England

APPLICATION was recently made to the Comptroller-General of Patents by an English firm for a license to manufacture and sell a German machine patented in England. Prior to the war this firm had made arrangements for the sale of the machine in England, buying it from the German makers, but the war had prevented this. The license asked was granted, and at the suggestion of the Comptroller the licensees agreed to pay patentees a royalty of 2½ per cent during the existence of the license, including the period of the war. Such fair treatment can hardly be questioned by the German patentee.

The How and Why of the V-Type Motor

(Concluded from page 21.)

consi'erable amount. Because for a given power, the cylinders in each bloc of the "Twin Six" are smaller than in a "Single Six," each impulse imparts less strain to the crankshaft. Therefore, the latter may be smaller and, as a rule, a single center bearing will be found sufficient.

It has been years since any phase of motorcar development has so taken the automobile world by storm as have the V-type "Eight" and "Twelve" during the past six months. It must not be inferred that the motors here illustrated are the only ones of V-type now in service. There is at least one more twelve-cylinder car, that of the "National" Motor Car Company, while the "Eights" have grown so numerous that we cannot begin to depict them all. Appearances indicate that the V-type has come to stay, although, as stated at the beginning, this type will be short-lived if it can be shown that a smaller number of cylinders can accomplish as satisfactory results.

But in thus pointing out the advantage of the eight- and twelve-cylinder motors over the "Four" and "Six," it must be borne in mind that the newer type has not as yet been in practical use a sufficient length of time for us to obtain data as to its durability and efficiency under all conditions. Faults have been met and overcome, and it will require months of operation in the hands of thousands of users for us to determine accurately what additional faults may arise and whether they, too, may be overcome or not. In a year from now it will be interesting to note the effect of the V-type motor on tire life, gasoline consumption and, most important of all, the driver's "nerves."

How Rifle Bullets Fly

(Concluded from page 24.)

the barrel point at a spot 16 feet higher than the thing we desire to hit, because of the one second we supposed our bullet would take, we have to adjust our sights to make the barrel point at a spot about 30 feet higher than the mark, because, with the constant slowing down of the bullet from the air, it takes 1.6 seconds to make the trip. Thus, the effect of the air in the first place is to make the flight of the bullet a very curved flight, and because of this high curve it has to describe to overcome the influence of gravity during this 1.6 seconds, it would completely miss a man half way out to the mark, even if the rifle were aimed dead at him, with the sights set for 900 yards or 2,700 feet.

Naturally enough, the faster the bullet starts from the muzzle of the rifle, and the better shaped it is to overcome the resistance of the air, the less time it requires to get over a given range. The less time it requires, the less it falls under the pull of gravity and the less it has to rise in its flight. And, rising but little, it is more likely to hit men along the line of its flight even though the sights are not set for the right distance, and the bullet be sent out for a range much farther on. In one case its path is that of the very swiftly thrown baseball, in the other its path is the half-brick slowly describing a parabola through the air. The baseball would not miss anything along the line of its flight by rising over it, the half-brick would not hit anything until it had fallen back toward earth.

This flat flight, termed a "flat trajectory," in military and ballistic parlance, is the most sought-for attribute of a military rifle. It means that if the range is misjudged, or if the soldiers forget to set their sights correctly, the chance for hitting the enemy is far greater. As judging a range, particularly if the enemy or our own men are on the move, is very difficult, the flat trajectory is most important.

Where one bullet, like that from the old black powder Springfield, might rise 10 feet in its flight, a modern bullet will rise but a third of this. The modern bullet would hit a man anywhere in its path; the old bullet would miss him save where it rose from the line of sight and returned to it. The modern bullet travels at terrific speed, nearly 3,000 feet per second; the old bullet traveled at low speed, not more than 1,200 feet per second.

Another consideration in being able to overcome air resistance and land a bullet at a certain spot with a considerable amount of its speed left is the fact that a bullet losing in speed loses frightfully in power. The United States 150-grain sharp-point bullet gets out to 900 yards with 1,140 foot-seconds left. It has the blow of 433 foot-pounds in energy. If it got there with all its 2,700 foot-seconds left, it would hit a blow of 2,430 foot-pounds. The difference between the energy of 433 foot-pounds and 2,430 foot-pounds has been taken from the bullet by its work of overcoming the resistance of the air in traveling little more than a half mile. So, just as the designer of a yacht studies every line and curve to aid in minimizing the water resistance, the bullet designer pares off the point of the bullet and gives it a lean entry to help it slip through the dense medium, air, at high speed.

Up to 1905, bullets for military rifles had blunt bows, almost canal-boat shape. They were as little adapted to slipping through the air as boats so shaped are adapted to slipping through the water. Since 1905 most of the civilized nations have adopted the sharp-pointed bullet, so-called spitzer. So efficient has this been in overcoming air resistance that the bullet designers were enabled to reduce the weight of our army bullet from 220 grains to 150, without in the least taking away from the ability of the missile to overcome the resistance of the air. With the bullet so lightened, they were further enabled to drive it at the rate of 2,700 feet per second instead of 2,000 feet per second, without adding to the recoil of the rifle, and they thus cut down the weight of the cartridge the soldier had to carry some 70 grains, or one pound for each 100 cartridges.

So important is the small matter of the sharp point on the bullet that adding it amounted to 70 grains out of the 220 grains in ability to drive through the air. If the present 150-grain American bullet were reshaped to the old blunt point used on the Krag-Jorgensen and on the bullets from the Russian army rifle of to-day and then were fired with the same muzzle speed, it would require 2 seconds to make the trip over 2,700 feet instead of 1.6 seconds, it would get there with only 900 feet per second speed left instead of 1,140 feet per second, it would have the punch of only 270 foot-pounds instead of 433, and it would have to rise in its flight 16 feet above the line of sight instead of 10.5 feet. And all of this is chargeable merely to cutting off the sharp point and making it the blunt point formerly used, and found on most American big game shooting bullets.

But the Americans and the Germans and the British have failed to go the logical limit in shaping bullets for flight through the air, and the Swiss have done this with their neighbors, the French. Both the Swiss and the French service bullets are purely boat-shaped, the bows long and tapering, and the sterns, instead of being cut off square like the United States bullet, taper back precisely like the stern of a racing yacht, to a diameter about two thirds the full width of the bullet. By this means the back-drag of the air, the vacuum that form" from the high speed of the bullet, is cut down and so is increased the ability of the bullet to hold its speed. There is startlingly little resemblance between the long, graceful, sharp-bowed and taper-stern French and Swiss bullets and the huge, stubby, blunt-nose, square-stern bullets used not many years ago.

The German Post Office and the German Army

(Continued from page 25.)

stations have been arranged along these lines, thus allowing assistance to be quickly rendered in cases of emergency. At the

(Concluded on page 31.)

Why Are My Fire Insurance Premiums So Much Higher Than These Six Concerns?

BY R. S. CHILDS

Paid Its Cost 12 Times in 8 Years

THE following experience of the Peerless Motor Car Company of Cleveland is remarkable but not unusual:

"Our records show that our Grinnell Automatic Sprinkler equipment has paid for itself about twelve times over in the saving of insurance premiums."

$1.11 Rate Reduced to 6 Cents

The experience of the Link Belt Company, Chicago.

"Have been equipped with Grinnell Sprinklers 6 years. During that time, loss by fire has been only $200. When we installed Grinnell System, our rate was reduced from $1.11 to $0.06."

Two Fires Extinguished

A letter from the Stromberg-Carlson Telephone Mfg. Co., of Rochester, reads as follows: "We installed Grinnell Automatic Sprinklers in 1905 and our immediate experience in the way of insurance rate reduction was extremely interesting. Our insurance rate was $1.50.

"As soon as the Sprinkler System was completed, our rate was cut from $1.50 to 20c. and has been cut a number of times since then.

"On the $2,000,000 worth of insurance which we immediately took out, we saved in the ensuing year $26,000."

These letters show the money-making phase of Grinnell Protection. But there is a far more interesting phase.

Prevents Business Interruption

Letters received lately from 50 great firms are in agreement that the worst result of fire is interruption of business—the disaster against which they cannot secure insurance. "Grinnells" absolutely protect them against this danger.

"We consider the greatest benefit of Grinnell Sprinklers the protection of the lives of our employees. Next, the prevention of business interruption," writes the West Virginia Pulp and Paper Company, who pay premiums on policies totaling $13,500,000.

The Insurance Department of Deere & Company, the largest plow makers in the world, says:

"We consider the prevention of large fires and interruption of business of the greatest benefit—the reduction in cost of insurance second. We think a reduction of 85% in the premiums paid is a fair estimate."

The opinion of the American Radiator Company: "We have considered the greatest benefit from a Grinnell System to be the increased assurance that our business will not be interrupted through loss by fire. The percentage of reduction in insurance premiums we would estimate at an average of 90%."

How the Grinnell System Works

In the dead of night, let us suppose, a fragment of oily waste kicked under a hot steam pipe, smoulders, smokes and silently ignites. The little blaze touches dry wood and presently there is a merry little bonfire. The watchman is a thousand feet away on another floor but overhead the Grinnell System stands guard. The ascending column of heat spreads and banks at the ceiling; the temperature up there climbs rapidly to 155°; there is a snap, a gush and spurt of water and a drenching spray rains down over a space ten feet square while the movement of water in the pipe rings the distant fire alarm and brings the watchman on the run. When he arrives the fire is probably nothing but a little black heap of soggy ashes.

Grinnell System Preferred

The Grinnell System is preferred the world over by men who want to be safeguarded against business interruption and demoralization. Some firms have put into their buildings Grinnell equipment costing $100,000 or more. They did not invest these sums merely in an Automatic Sprinkler installation, but in Grinnell Scientific Protection against business disruption by fire. As big buyers of business equipment they gained the knowledge—

First, that metallurgists, engineers, and fire protection experts all grant the superior fire fighting qualities of a Grinnell System.

Second, that individual Grinnell Systems have proven their infallibility by putting out as many as 102 different fires in one building.

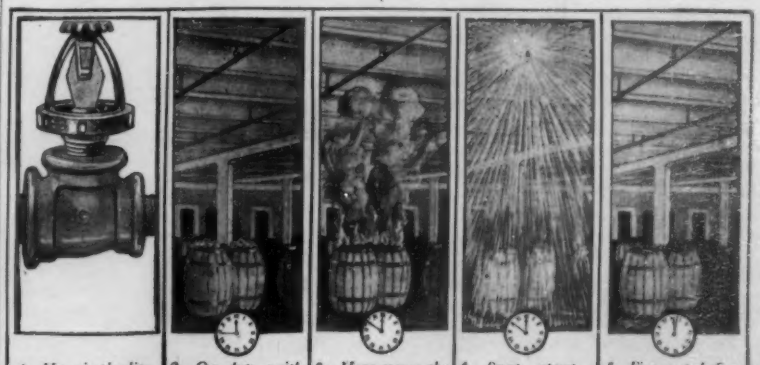
Third, that Grinnell Systems have a thirty-three year record of putting out fires with an average loss per fire of only $265.

Let the System Finance Itself

And the astounding fact about it all is that business houses throughout the country, small as well as large are securing Grinnell Systems without one penny of expense, either initial or final.

Numerous construction companies will install the system free on the simple basis of meeting deferred payments with your premium savings each year.

Without obligating yourself in the least, you can secure complete information. You have simply to write the General Fire Extinguisher Co., 291 West Exchange Street, Providence, R. I., stating the total floor area of your buildings (including basement and attic), insurance carried on building and rate, together with insurance carried on stock, and rate. Your inquiry will be answered by letter, will not result in any annoying solicitation, and is almost sure to show you a way to an annual saving of at least 50% of your present fire insurance cost.



1. Here is the little Grinnell Sprinkler head, always ready for business; 33 years experience behind it. Twenty million now in use.

2. On duty with manyothers, waiting for a fire—waiting perhaps for thirty years, up in the dust and cobwebs near the ceiling.

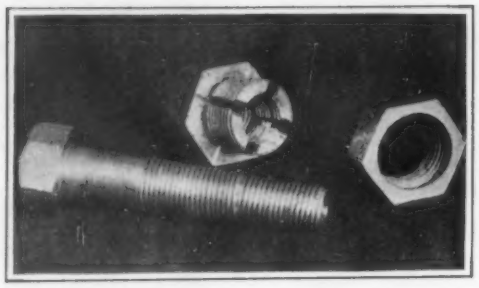
3. Here comes the fire at midnight! The column of heat rises and at 155° the fusible strut in the nearest Grinnell softens and melts.

4. Snap—spurt—splash! A drenching downpour right on the heart of the fire and there only. Alarm bell clanging in the distance.

5. Fire out before watchman arrives. Water turned off. No damage worth reporting. Next morning—business going on as usual.

A Combined Bolt and Lock-nut

THE accompanying photograph shows a novel form of bolt and lock-nut. The bolt is fitted with both a right and a left-hand thread. The left-hand thread is just one size smaller in diameter than the right-hand thread. The purpose of this is to let the main nut slip over that part of the bolt without engaging. The main nut, which is the larger one, is fitted with an extension barrel that is quartered to make it resilient. This nut on the inside at the base is fitted with a right-hand thread, and in the extension end with a left-hand thread on the inside. The other nut is a tapered nut and works altogether on the extension barrel of the main nut. The taper is on the inside of the nut; it has no communication whatever with the bolt. To use the device, simply screw down the main nut to the desired point, then screw down the tapered nut on the main nut. It clamps the extension barrel of the main nut down on a left-hand thread and makes a nut that works diametrically opposite to itself. Loosening one end tightens the other, and in that way a nut is made that is not loosened by vibration.



A combined bolt and lock-nut.

Sculptor's Pneumatic Chisel

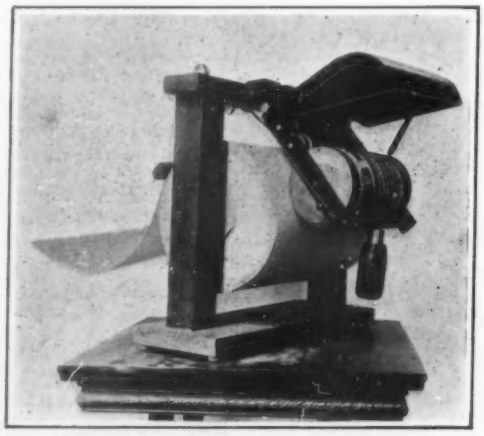
LORADO TAFT, the Chicago sculptor, has installed in his studio a pneumatic chisel by means of which the work of outlining marble statues is greatly simplified. The old method of carving with mallet and chisel is not only laborious, but rather awkward for the sculptor, since only one hand is left free to guide the chisel. In the case of the pneumatic chisel both hands may be used for this purpose.

The pneumatic chisel is driven by compressed air, at a pressure of 77 pounds per square inch, operating through a flexible tube, the air being compressed in a large tank by means of an electric motor. The air passing through the tube has the effect of driving the chisel back and forth against the stone just as if it were hit by a mallet. The chisel, of course, is used only to outline the statue roughly, the finishing work all being done by hand.

Carving marble statues with a pneumatic chisel.

Wrapping Paper Printer

A LITTLE invention that bids fair to become useful to the druggist and small merchant is an attachment for the ordinary roll of paper seen on most counters. The mechanism prints considerable advertising matter upon the sheet of paper as it is being pulled from the roll. It is simplicity itself and the wonder is that some inventive genius has not stumbled upon the idea before. A wooden roller with the type fitting on its circular body rests upon the paper and the imprint is made immediately without the least exertion. The apparatus is but a metal arrangement that can be fastened to any paper rack through the aid of a thumb screw. The automatic printer not only prints the wrapping paper, but will print paper bags as well. The thumb screw is simply released from its fastening and the type is rolled across the face of the bag.



Printer for wrapping paper rolls.

Commissioner Ewing in the Patent Office

ONE of the greatest reforms introduced in Patent Office procedure by Commissioner Ewing is a system in the declaration of interferences that cannot help but avoid useless interferences. Thus now an interference is not declared until it has been considered not only by the primary examiner, but by such primary examiner in connection with a law clerk assigned to this duty. This leads to uniformity in the practice of declaring interferences in the first instance. Then, when the interference is declared, motions for dissolution brought on the various grounds assignable for such action are transmitted, not to the primary examiner who initiated the interference, but to a law clerk who considers all such motions, thus establishing a uniformity in connection with actions on motions to dissolve. In this way not only uniformity is secured, but there is a review of the work that appears to give excellent results in the transaction of this class of business.

In connection with design applications the Commissioner has permitted the practice of filing applications for design for the shorter term and then enlarging the term of the patent after the application has been favorably considered. This results in a large saving to applicants in cases which are held to be not patentable as designs, since it involves payment only on the filing of a design application of the minimum design fee. The Commissioner has also secured the passage of a statute dispensing with the attesting witnesses to the applicant's signature to the specification and to the drawing, saving the delays occurring frequently because of the failure of the party to secure a proper attestation of signature. The Commissioner has also proceeded, by means of a committee organized for the purpose, to a revision of the rules.

Possibly none of the improvements above mentioned inaugurated by Mr. Ewing has been so far-reaching in its effects as that seeking to avoid so-called delayed applications and to enforce upon the applicant a reasonably prompt prosecution of the application, which practice has been successful in a clearing out of most of the old applications which have dragged along through many years. The improvements so far inaugurated, it is hoped, only indicate the many other improvements that will mark the continuation of Mr. Ewing's administration.

Testing a railroad bond.

Some Adjudicated Patents

IN Ashley v. Weeks Numan Company, the Ashley patent, No. 42,077, for a design for an ink-stand, was held valid and infringed; in Baker & Bennett Company v. N. D. Cass Company the Baker design patent, No. 45,249, for a design for sets of character blocks, was held void for lack of invention; the Gathright patents, Nos. 436,916, for a tabulating mechanism for typewriters, and 452,268, for improvements thereon, were held valid and claims 4 and 6 of the former held infringed and the latter not infringed in Underwood Typewriter Company v. Fox Typewriter Company. In American Ballast Company v. Davy Burnt Clay Ballast Company, the Simmons-Forgham & Bennett patent, No. 633,348, for a coal unloading and distributing apparatus for use in ballast burning, was held void for prior use, and in a suit between the same parties the Bennett & Forgham patent, No. 686,964, for apparatus for use in producing burnt clay ballast, was held not infringed. The Ellis patent, No. 714,880, for a paint and varnish remover and process of making same, was held valid and infringed as to claims 6, 7, and 8 in the Chadeloid Chemical Company v. F. W. Thurston Company; and the said Ellis patent, No. 714,880, for a paint remover, was held valid and infringed in Chadeloid Chemical Company v. Wilson Remover Company. The Vogel patent, No. 737,796, for a flushing apparatus, was held valid but not infringed; and the Vogel patent, No. 801,754, for a flushing apparatus, was held valid and claim 5 held infringed in James A. Vogel Company v. A. Weiskittel & Son Company. In Dayton Engineering Laboratories Company v. Sidney B. Bowman Automobile Company, the Coleman patent, No. 745,157, for an automatic starting system for motorcars, was held valid and infringed, and in a suit between the same parties the Coleman patent, No. 842,827, for an automatic starting system for motorcars, was held valid but not infringed. The Woerheide patent, No. 973,902, for a cleat for securing prepared roofing, was held valid and infringed in Woerheide v. H. W. Johns-Manville Company.

German Railways in Wartime

SINCE the beginning of the war all German railways have been controlled by the military authorities, through the military controllers that are attached to each line, even in time of peace. In conquered territory the railways are operated directly by the military authorities with the aid of railway men who have joined the army.

Movements of troops are usually made on short notice and they cannot be accomplished punctually unless the military controllers have complete command. This is the essential difference between conditions in war and in peace.

The first care of these officials is to provide the required trains at the proper time and place, the second to assure the safe operation of these trains on short headway. The problem of feeding men and horses on the journey also requires much forethought and preparation. These objects are accomplished very satisfactorily, despite the fact that a large proportion of the railway employees, and even of the rolling stock, is at the front.

All this is done, according to the Berlin *Lokal-Anzeiger*, without seriously interfering with ordinary passenger traffic, even with the fast trains, but freight traffic is subordinated to military needs.

Testing Railway Bonds

THE accompanying illustration shows the use of a novel rail bond tester developed at Bethlehem, Pa., which is of special interest. It enables one man to compare three feet of bonded rail with three feet of unbroken rail and reads direct in equivalent length of unbroken rail. It ordinarily uses the current in the rail and accuracy is independent of amount of current, this influencing sensibility only.

In places where the current in the rails is small or intermittent, or in new construction, a special high sensibility instrument is used, the current being obtained from portable storage batteries.

In order to operate this high sensibility instrument two men are required. The instrument weighs six pounds and when closed measures 5¼ by 8¼ by 7½ inches. The contact bar carries renewable saw blade contacts which will not fail to make good contact. The bar may be folded for easy transportation. In operation, a section of the bar is made to span the joint. The central button of the instrument is then rotated until the galvanometer needle at the top comes to 0. The rotated needle then indicates directly on the scale the length in feet of an unbroken rail having the same resistance as the bonded section.

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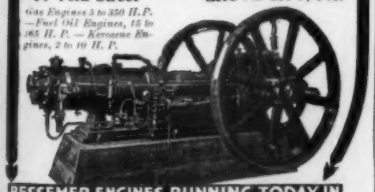

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Cos Cob, Conn.

end of each communication line there is what is called the "chief place of the base," which is under the charge of an *inspecteur* or superintendent, a high official of general rank. Immediately under his orders is the highest postal official of the army in question, viz., the Army Postmaster, who controls the whole of its postal service. Each army corps comprises a field post office, and another post office is attached to the staff of each division, the headquarters of each army and each cavalry division. The Great Headquarters, of course, comprise likewise a field post office.

The Field Post travels along the Communication Line, from one relay station to the other, until reaching the "chief place" of the base. Thence it is dispatched to the various mobile Field Post stations which, radiating from the end of the Communication Line, reach as close as possible to the different detachments. The work of the Field Post ceases here. Addressees do not, of course, receive their mail from a postman, but each detachment has to send for its mail matter. Sometimes the field postilions, equipped with large bags, will, during intervals between engagements, approach to the very fire line, in order there to collect the soldiers' mail for their families at home. The home mail from the army goes the same way in an opposite direction, being taken to the mobile Field Post station, thence to the "chief place" of the base, from one relay to the other, and to some home post office where the sorting is mainly effected.

It would be too long to enumerate all the dangers due to the vicissitudes of war, to which the Field Post is exposed. How often have not postal vans, especially in the first times, been attacked by the enemy or hit by bombs! Many a time the mail matter just arrived from home had to be left on the sudden approach of the enemy; such cases would happen especially in eastern Prussia, during the Russian invasion. When the enemy had then been thrown back, the mail would often be found again in its hiding place, safe, though several weeks older.

The army postmaster each morning receives from the mobile Field Post stations notice of their quarters for the day, unless these, for urgent strategical reasons, have to be kept secret or else cannot be foreseen. In such cases, which fortunately are exceptional, the Field Post service of an army may undergo a temporary interruption without anybody knowing the reason, and much anxiety may be the consequence.

Apart from the letters, post cards and postal money orders, enormous quantities of small parcels, containing refreshments, warm underwear, etc., are sent to the front by loving mothers and wives, as well as by charitable institutions, etc. All more voluminous packages of this kind are conveyed by parcel post, mainly by the army authorities themselves, independently of the Field Post proper. In the week preceding Christmas no less than eight millions of such parcels were sent to the soldiers, and collections were also made for Easter presents.

The Machinery of Modern Submarines

(Continued from page 26.)

the fuel into the cylinders after the compression stroke, this being carried out instead by mechanical means. The advantage of this arrangement is that the air compressors, which are frequently a source of trouble on Diesel engines, are dispensed with, while there is at the same time a reduction in weight and space occupied by the machinery.

In one or two British submarines the Fiat type of engine, as developed by the Turin firm, has been employed, and it is therefore worthy of note that the largest submarine Diesel engine of which details are available has recently been built by that firm, this machine being illustrated in Fig. 3. It is of the two-cycle directly reversible type, developing 1,300 brake horse-power at 400 revolutions per minute in six cylinders. Like the Nuremberg engine, the scavenging pumps are arranged

(Concluded on page 33.)

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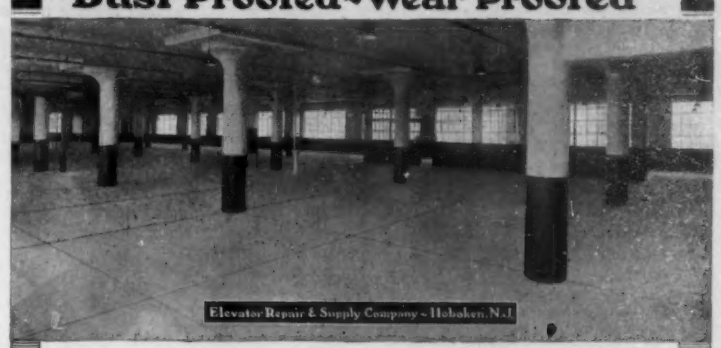

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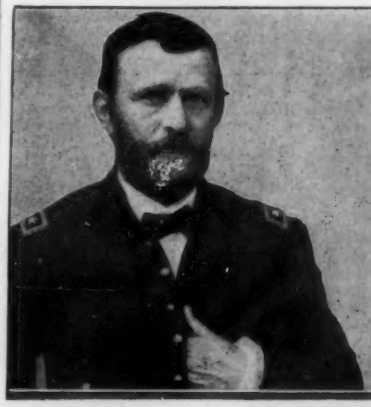

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

BEAUTY MARK.—F. FRANKEL, 648 Broadway, New York, N. Y. This invention relates to an article which is termed in the trade a "beauty mark," and which is used by women as a part of their toilet to enhance the attractiveness of their appearance. The novel feature in this case is the application to courtplaster of a sparkling stone, which is somewhat smaller than the courtplaster so that the marginal portion of the latter will form a border around the stone.

Electrical Devices.

COILING DEVICE.—L. E. HAYNES, 630 3rd Ave., Salt Lake City, Utah. The invention provides a means to automatically coil the cord or other flexible element to which the device is applied and holds the coil with its convolutions in close relation, the arrangement permitting the cord to approach a straight form by extension in the line of its axis or approximately so in response to a pull thereon.

SANITARY TELEPHONE ATTACHMENT.—T. H. R. MILLER, 50 Church St., New York, N. Y. This invention simplifies and improves the construction of transmitter attachments so as to be reliable and efficient in use, and so designed as to be easily and quickly applied to the mouthpiece of the transmitter and effectively retained when once applied.

Of Interest to Farmers.

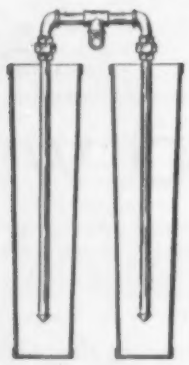
CULTIVATOR.—J. E. EVANS, Lyons, Kan. The improvement provides a cultivator arranged to enable the operator in charge to readily shift the pole sidewise, relative to the main frame carrying the plows, to steer the cultivator properly. The invention insures a uniform equalizing pull of the team on the cultivator.

Of General Interest.

HASP FOR SUITCASES.—T. J. CARROLL, Clifton, Ariz. The object here is to provide a strong and inexpensive hasp, forming an umbrella fastener, which can be readily and easily attached to a dress or suitcase or any other similar case, when the case is made or to a case already in use.

CORRUGATED PIPE.—F. N. HOLMQUIST, Phoenix, Ariz. The invention relates to the formation of pipe, and also to the joining of separate members thereof, and the main object thereof is to provide a pipe formed of sheet metal previously corrugated diagonally. An object is to corrugate the sheets of metal so that the pitch of the corrugations, or the width thereof, will be such as to have the corrugations at the overlapping edges of the sheet register and thus form continuing spirals in the completed pipe.

WATER AGITATOR FOR ICE CANS.—J. C. TABY, J. H. STRAUB, and D. M. MAURER, Shamokin, Pa. This invention relates to the art of making artificial ice and has to deal more particularly with means for agitating the water in ice cans in the early stage of freezing. This invention improves and simplifies the construc-



WATER AGITATOR FOR ICE CANS.

tion and operation of air supply devices for ice cans so as to be reliable and efficient in use and so designed as to economize the time of the attendant and be comparatively inexpensive to install and keep in operative condition.

BACKING FOR ARTIFICIAL TEETH.—A. J. ASCH, care of William Kaufman, 7 Beekman St., New York, N. Y. The improvement has for its general objects to provide a means for interchangeably and replaceably mounting the facing of a tooth on a base or body of the bridge, crown or plate by the use of a backing so designed that it will be permanently secured in place, and to which the facing of the tooth is fastened.

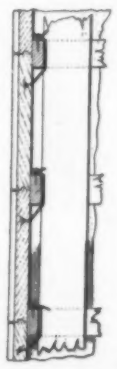
SIGN AND HOLDER.—W. C. GRAEBE, 72 Himrod St., Brooklyn, N. Y., N. Y. Among the principal objects which the invention has in view are to provide a sign and holder therefor for repeated employment; and to provide a frame for said sign, for maintaining a neat appearance. With this sign and holder real estate signs having the legend "For Sale" or "For Rent" may be frequently applied to a standing structure without marring the same.

METALLIC BUILDING.—W. W. TAYLOR, 219 Glenridge Ave., Montclair, N. J. The present application is a division of an application filed by Mr. Taylor on March 14th, 1913, Serial No. 754,216; and is based on the novel features pertaining to means for supporting the roof of the structure, and to the roofing plates and siding plates formed to co-act with the novel roof-constructing means.

POUR OUT STOPPER.—J. T. CRAW, 33 Ege Ave., Jersey City, N. J. The improvement has particular reference to that type of bottle stoppers which are adapted for use upon ink bottles especially, and which serve not only as a means for sealing the bottles, but as means for delivering the ink therefrom whenever and wherever desired in a safe, convenient and expeditious manner.

AUTOMATIC FIRE EXTINGUISHER.—E. DAUCHER, Woodside, L. I., New York, N. Y. The invention consists of an automatic fire extinguisher and the object in view is to simplify and improve devices of this character in such a manner as to cheapen their structure, facilitate their operation by causing them to operate without extremely excessive heat and to sprinkle the water for the extinguishing of the fire over a large area.

FACING BLOCKS.—F. G. NIEMEYER, 1130 West Hull St., Denison, Tex. This invention relates more particularly to an improved veneer or facing for use with wooden or metal framework. It provides an improved facing block having means for facilitating the ready connec-



FACING BLOCKS.

tion of the block with the frame-work of a building. It provides a frame-work facing made up of a plurality of blocks having uncemented tongue and groove connections with each other and having each a single point of suspension from the frame-work, whereby relative movement and adjustment may be had between the blocks, upon vibration or settlement of the frame-work.

KNOCK DOWN SEAT.—M. H. WRIGHT, 106 N. La Salle St., Chicago, Ill. The invention provides a device which may be easily taken apart or set up when occasion demands. It provides a device which in its "knocked down" condition may be easily transported because it takes up very little space, and is of exceedingly light weight when its general stability is taken into consideration.

TRUSS.—T. A. MACDONALD, 336 Knickerbocker Ave., Paterson, N. J. An object in this case is to provide a device by means of which a rupture may be permanently healed in a comparatively short time. It also provides a device in which there is an adjustable pad that may be moved to withdraw pressure as the wound heals.

Hardware and Tools.

NUT LOCK.—F. A. HARRIS. Address Harry L. Cohn, attorney, Spokane, Wash. One of the principal objects of this invention is to provide a nut lock by means of which a nut may be locked against reverse rotation on a bolt, the improvement embodying an arrangement whereby the nut may be removed from the bolt at will without mutilating either of them.

Heating and Lighting.

LAMP FOR BARBERS' CHAIRS.—A. SCLAFANI, 157 West 47th St., New York, N. Y. This address corrects the one given in a recent issue of this journal.

Household Utilities.

STOVE LID.—N. E. RICE, 3160 Little A St., Eureka, Cal. This invention relates to stove lids, and more particularly to a lid adapted for use with wood and coal stoves or ranges of ordinary construction. One of the principal objects is to provide a lid having means whereby the heat may be thrown into direct or indirect contact with a vessel supported on the lid.

CLOTHES LINE SUPPORT.—C. KOFFER, 96 Essex St., Brooklyn, N. Y., N. Y. This invention provides a construction of clothes line support designed to be pivotally connected to the outside part of a window frame and arranged to swing into the room through the window or to a position outside of the window without changing the tension on the clothes line connected therewith.

PNEUMATIC SUCTION CLEANER.—E. A. MARTIN, 445 W. 44th St., New York, N. Y. The invention provides a double acting suction cleaner which may be propelled over a surface to be cleaned in a manner which will accomplish the desired result with the least possible expenditure of energy. The parts of the cleaner may be readily removed to transform the double acting cleaner into one with a single action.

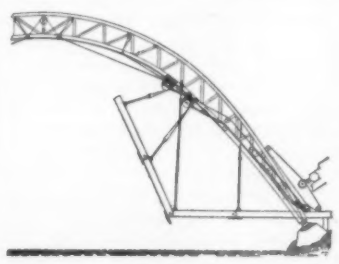
Machines and Mechanical Devices.

ENDLESS CARRIER.—W. J. TURNBULL. Address H. W. Hille, 306 Wells Fargo Bldg., New Orleans, La. The invention provides an endless carrier made up of units of such shape that the carrier presents a practically continuous upper surface, while the units of which the carrier is former readily pass around the ends of the frame upon which they are supported.

TREADLE OPERATED DRIVING MECHANISM.—G. G. WHITE, 1919 Union St., St. Joseph, Mo. One of the principal objects here is to provide an improved treadle driven motor or operating mechanism, providing means for preventing dead centering of the machinery, whereby the same may be started by foot, with the treadle in any position in its path of movement.

VALVE.—N. B. CREIGHTON, Chicago St., between Horton and Ivy Sts., Elmhurst, L. I., N. Y., N. Y. This inventor provides a valve arranged to normally hold the valve in an open position for the passage of gas, liquid or other fluid, to allow the valve to close automatically in case of a fire and to permit releasing the valve from a distant point whenever it is desired to close the valve with a view to stop the flow of fluid through the valve.

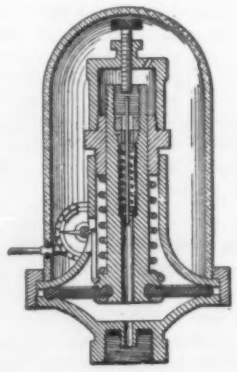
DRAWBRIDGE.—H. A. ICKE, 1517 Quadra St., Victoria, British Columbia, Canada. This invention relates to bridges adapted to be moved out of the way of traffic, such as vessels when the bridge is over a waterway, and it



DRAWBRIDGE.

has particular reference to what are technically known as bascule bridges, and one of the main objects is to provide flexible suspension means for the bascules and means movable along an overhead arch for flexing said suspension means to raise the bascules and thus form a gap for the passage of vessels.

AIR VALVE AND INDICATING MECHANISM.—H. B. ASHELMAN and J. S. JOHNSON, Fargo, N. D. The invention relates to air valves of a type suitable for use in connection with pneumatic tires, and to indicating mechanisms associated with such valves and tires,



AIR VALVE AND INDICATING MECHANISM.

for indicating the amount of air pressure contained within the tires. More particularly stated, the air valve is mounted upon a wheel such as an automobile wheel, and connected with a pneumatic tire carried by such wheel, the air valve being provided with indicating mechanism for disclosing the amount of air pressure carried by the tire.

Musical Instruments.

MEANS FOR TUNING SOUND PRODUCING BARS OR TUBES.—PAUL T. YOUNG, 34 Graduate College, Princeton, N. J. The object of the invention is to provide a new and improved means for tuning sound-producing elements of musical instruments of the type referred to, and arranged to permit the player quickly and accurately to adjust the sound-producing elements to either concert or international pitch.

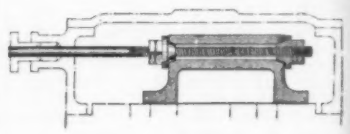
Prime Movers and Their Accessories.

VAPORIZER FOR INTERNAL COMBUSTION ENGINES.—G. J. BOUTET, 39 and 41 Rue des Cloys, Paris, France. In the present patent the invention has reference to an apparatus permitting to use in internal combustion engines the most diverse liquid fuels and particularly those which are not volatile to the ambient atmosphere, such as the heavy hydrocarbons, kerosene, schist-oil, etc.

FUEL ATOMIZER FOR INTERNAL COMBUSTION ENGINES.—T. C. CROUCH, Saskatoon, Saskatchewan, Canada. In this instance the purpose of the inventor is the provision of a device by means of which heavy fuels, such as kerosene, may be readily atomized so as to work efficiently in engines that are designed to be worked with lighter fuel, such as gasoline.

TURBINE WHEEL.—W. J. FRANCKE, Highland Park, N. J. This invention provides a turbine wheel which is simple and durable in construction and accurately balanced to allow running of the wheel at a very high speed. The wheel is formed of plates having alternating buckets extending integrally from the front with their faces at an angle to the faces of the plates.

SLIDE VALVE.—J. W. MILLER, Rantoul, Ill. This invention provides a valve which will automatically find a seat and which, at the same time, position the valve with respect to the ports. It provides conical stops for the valve movement on its rod, whereby the valve travels a predetermined distance up the bevel or incline of the corresponding cone upon



SLIDE VALVE.

the abrupt stop of the rod to begin its reverse movement, this acting as a cushion for the valve to take the valve impact resiliently and thus avoid beating off the flanges of the valve ends, and also the stripping of the screw-threads on the rod.

ADJUSTABLE PISTON RING PACKING.—J. CARROLL, Tompkins Place, Brooklyn, N. Y., N. Y. This invention has reference to improvements in pistons, and piston ring packings, and has for an object to provide a structure wherein there will be no pressure of the expanding ring against the cylinder and consequently no appreciable wear thereof.

ENGINE COOLING SYSTEM.—F. E. KUBE, Harrison Street Road, Clinton, Iowa. The object here is to provide a system of cooling the sleeves. This is obtained by providing hollow sleeve valves through which a cooling fluid is made to flow; and also by directing a cooling medium on to the surface of the sleeve engaged by the piston.

Pertaining to Vehicles.

POWER TRANSMISSION GEAR.—O. E. WOOLDRIDGE, 117 S. 6th St., Greenville, Ill. This invention relates to transmission gears of the variable speed type adapted especially for use in connection with automobiles for transmitting power from the prime mover to the traction wheels, and it has to deal more especially with speed transmitting mechanisms in which a cushioning means is employed to transmit motion from a driving to a driven element, whereby the shocks are eliminated in changing from one speed to another.

AUTOMOBILE ENGINE LOCK VALVE.—J. G. RITZ, 186 Jefferson St., Brooklyn, N. Y. The object in view in this case is to provide a locking valve which will positively prevent the operation of the engine when the valve is in a locked position, the location of the valve being such that the removal or tampering of the valve cannot be done with the hope of starting the engine.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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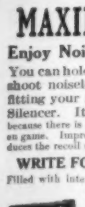

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directly beneath the cylinders, while there is a single air compressor at the end driven directly off the crankshaft. Two of these engines have been built for installation in a 700-ton, 20-knot submarine, which in the matter of speed appears to be an advance upon any existing underwater craft.

Two other types of submarine engines may be mentioned, these being the one built by Sulzer Brothers, in Switzerland, and the other by the Polar Company of Stockholm. The first, illustrated in Fig. 4, has been used in American and Japanese submarines, and is a two-cycle reversible engine, the chief peculiarity being that valves in the cylinder head are, as far as possbile, dispensed with, this being effected by admitting the scavenging air at the bottom of the cylinders through ports opposite the exhaust port, instead of through valves as in most types of two-cycle motors. As will be seen from the illustration, the result is that the motor appears less complicated than the other designs.

The Polar engine, Fig. 6, is used on Swedish submarines, and its chief interest centers in the means employed for reversing. It is a four-cycle engine, and in order to avoid complication, arrangements have been made so that when it is desired to run in the astern direction, the exhaust valves become the air inlet valves, and *vice versa*.

Superheated Steam in Torpedo-boat Engines

By Warren H. Miller

THE 6,500 horse-power Lanz torpedo-boat engine described herewith is an example of modern German steam engineering of considerable interest, since it shows the successful introduction to marine practice of a compact yet powerful engine especially designed to utilize superheated steam of high temperature. Incidentally the cleaning up of the engine mechanically, in the elimination of the ahead and astern Stevenson links, so full of trouble to the operating force, is a feature that will be appreciated by men who have to run marine engines. During the long run at sea, how many times one can recall how this or that eccentric strap began to heat, for no reason at all, required the water service on it for maybe a week, and then subsided as mysteriously and suddenly as it began! When you multiply the eccentric straps by eight, as in any triple expansion engine with two low pressure cylinders, you begin to realize what a boon cleaning them all off the engine, as is done in this Lanz ventil-geared unit, will be to the operating force and to the upkeep account.

The lines along which steam engineering can advance in reciprocating engines are clear and well defined; by uniflow handling of the steam and high superheat, either or both of which eliminate the big 30 per cent loss of cylinder condensation; or by utilizing the work in the last inches of the vacuum when fully a third of the heat in the steam can be turned into mechanical work instead of being rejected to the condenser. The new German locomobiles, or superheated steam units, in which the steam is superheated for both high and low pressure cylinders, show what striking economies are possible by eliminating cylinder condensation; and the steam turbine, utilizing the kinetic energy of the last inches of the vacuum, demonstrates what a really efficient medium steam is compared to the gas engine and producer combination if it is handled so as to utilize the heat that is in it.

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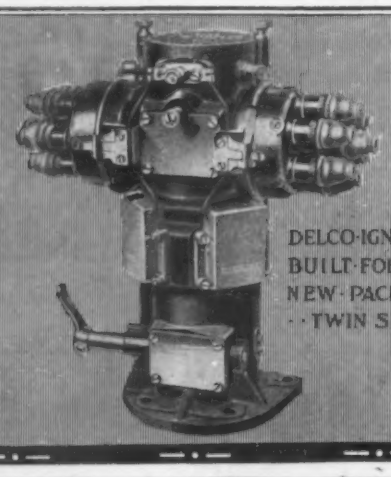

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best compound engine at 4:1 cylinder ratio usually rejects into the condenser at about 4 pounds absolute, from sheer inability to contain and use these large volumes of aqueous vapor. As the turbine also offers no mechanical obstruction to the use of superheated steam, it has become a formidable competitor of the reciprocating engine in torpedo boat service.

But it has its disadvantages. Its condenser weighs twice as much as that of the reciprocating engines for the same service, the combined turbine and condenser weighs one and one half times as much as the engine and condenser, the turbine must turn at about 650 revolutions per minute while the engine does 250 revolutions per minute, and by overload or vacuum loss the engine is much the less disturbed. A happy middle course between the heavy turbine and the ordinary triple expansion engine consists in using superheated steam and going direct from high to low, providing three low to one high-pressure cylinder to get good volumetric efficiency. This has been carried out in the design adopted for the torpedo-boat engines of many of the German destroyers.

But the economies and advantages of using superheated steam are not to be had in ordinary triple-compound engines. They are not to be made use of without due provision for the high temperature of superheated steam, wherein the best results are got by feeding the high-pressure cylinder with steam superheated to 580 deg. Fahr. expanding it to 230 degrees, reheating to 360 and again expanding in the low-pressure cylinder to 90 degrees, when it is rejected to the condenser. This *régime* practically eliminates cylinder condensation in both cylinders, a gain of 30 per cent in the economy of the engine. This in turn means a corresponding reduction in the size of the boilers, with a resulting shrinkage of absolute stack losses so that the actual boiler equipment is cut nearly in half, likewise the coal consumption, thereby doubling the cruising radius of the torpedo boat, the limitations of which latter is the principal weakness of this class of fighting craft.

But superheated steam of 580 degrees is beyond the flash point of most cylinder oils, and hence is very hard to use with large piston valves and grid slide valves, such as are used in marine torpedo boat service. Something frictionless, that will permit oiling the cylinder *via* the piston rod, is required. Wherefore, dating back to about 1870, there had been developed in France and Germany what is known as the ventil system of valve gear to meet these requirements. Three factors caused it to largely displace the slide-valve in Europe—the use of superheated steam in general power plants, the introduction of high speed engines, and the requirements of engines driving paralleled alternators for close and exact governing. As the ventil system is nothing but four balanced pop valves admitting and releasing steam, it involves no sliding friction, takes no power to operate, and therefore permits a light sensitive governing gear at even speeds as high as 400 revolutions per minute. For the extreme use of these ventil gears on stationary engines one has only to point to the installations of Bollinckx, Testi, Krupp, Dujardin, etc., which cover continental Europe, and to the well-known locomobile units of the Lanz and Wolf companies, of which specimens over a thousand horse-power in size are now operating.

The Lanz Company of Mannheim is the one which has introduced the ventil gear into marine service with considerable success, it being at present a formidable competitor of the turbine in economy because it permits the use of highly superheated steam with its attendant coal and boiler weight reductions. The 6,500 horse-power Lanz torpedo-boat engine represents a decided advance in marine engineering, particularly in naval service. The elements of the "Lentz system" of ventil or pop valves used in this engine are two balanced valves controlling admission at either end of the cylinder, operated by the same cam, and two balanced pop valves controlling exhaust in the same manner,

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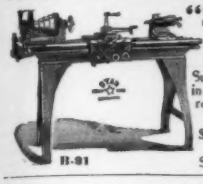

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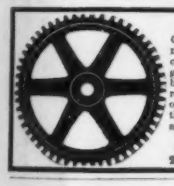

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the cam acting alternately on the stem of either valve. The cams are circular, with abrupt rise to maximum lift, which need be only a very small amount to develop the entire area of the valve. Each ventil, being double-seated, is balanced, taking very little power to operate, wherefore the valve stem is slender, only of sufficient diameter to permit cutting suitable labyrinthine packing on it. The stem is then ground into the bore of the stuffing box, which makes it steam-tight without any packing except a loose circular steel plate which condenses any wisp of steam which might get through.

It will be at once noted that this valve gear makes a remarkably clean engine; no ahead and astern eccentric straps with their attendant valves, in the ordinary marine engine quite as much a care as the piston and connecting rods. One has merely the main bearings to look after, a good practical consideration, particularly in torpedo boat service. The cranks are set in pairs at 180 degrees and 90 degrees apart between pairs, so that one has always either two impulses at mid-stroke or all four in quarter-stroke, getting a practically uniform turning moment.

The ventil valve chambers are far smaller for the same port opening than with piston valves, and the head card is not tied to the crank-end card with such a rigid steam distribution as is inevitable with the piston valve, which must control both admission and exhaust with the same valve. One has much more latitude in arranging admission and compression at given loads without running into "pig-tails" and other curiosities often met in marine practice.

For superheated steam the ventil system has the further advantage over the piston valve in that, as the latter must handle both admission and exhaust, it is subject to alternate temperatures at the edges of 580 and 230 degrees, thus losing much heat by conduction, whereas the ventils operating continuously in the same independent temperatures have no such disadvantages.

The dimensions of this torpedo-boat engine are: High-pressure cylinder bore, 1,000 millimeters; three low-pressure cylinder bores, 1,000 millimeters; crankshaft, 500 millimeters diameter; steam, 240 pounds; speed, 250 revolutions per minute; indicated horse-power, 6,500. It has been adopted by many of the torpedo boats now in service in the German navy.

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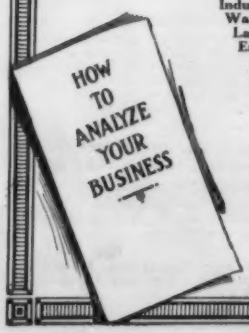

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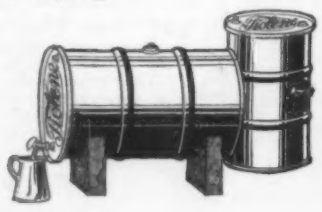

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(13062) "A Reader," in Montreal, is informed that his questions are worthy of reply, but cannot be answered as he does not send his name.

(13063) J. H. J. writes: Some time ago an article appeared in one of the technical papers on a discovery which was a sort of a wax or rosin base which when heated would radiate heat for a number of hours, from the one heating. What is it? A. A number of years ago there appeared on the market a bottle, which was first heated by placing it in a kettle of hot water, after which it would give off its heat for a long time. The substance which it contained was said to be hyposulphite of soda, which was fused in hot water, and then as it crystallized gave off its heat of liquefaction slowly. If the bottle were shaken it became warmer again, because the crystallization was made more rapid. We do not find any reference to any article printed in cur papers about this.

(13064) A. D. D. asks: Is an American mile of the same length as an English mile? A. The British and the American statute miles are of the same length, 1,760 yards. The British and the American nautical miles are not exactly of the same length, although the difference is slight. The mile is an ancient measure. We derive it from the Romans, by whom it was called a "thousand steps," *mille passus*. The last word was omitted and the name became *mille*, our mile. This mile was not so long as ours, being 1,617 yards. Our mile of 1,760 yards was made legal in the thirty-fifth year of Queen Elizabeth's reign. The medieval English mile was 6,610 feet, while the old London mile was 5,000 feet. Since the time of Queen Elizabeth the legal mile has had the same length as now, and our forefathers brought it to this country when they settled here. The U. S. Coast Survey has adopted a value of a geographical or nautical mile to be one sixtieth part of the length of a degree of a great circle of a sphere whose surface is equal to the surface of the earth. Its value is 6,080.27 feet. The nautical mile of the British Admiralty is 6,080 feet. The difference is a trifle more than three inches.

(13065) I. W. H. asks: I have been mixing my own flashlight powder, but am looking for one that gives little smoke. I have heard that one containing cerium nitrate makes but little smoke. Can you tell me about how this one is made up, or of another which is not objectionable from the smoke standpoint? A. A flashlight powder using cerium nitrate may be made by this formula: Magnesium powder 100, cerium nitrate 70, and strontium carbonate 30 parts. This is a slow-burning mixture, 80 grains burning in about 6 seconds. It is more common to set off the flash in a flashbag, so that the smoke will not escape into the room at all. The bags can be had from dealers in photographic supplies.

(13066) C. M. sends us a large spool, to the smaller part of which a cord is attached by means of a small nail. If the spool is laid upon a level table and the cord is pulled in a horizontal line, the spool rolls toward you and winds the cord up on the drum of the spool. He asks the explanation of the singular action of the spool. A. The spool rolls toward you because the pull is in that direction and the friction of the spool on the table is greater than the force required to make the spool roll on the table. Rolling friction of any body is less than sliding friction. To show that the friction is the cause of the spool rolling toward you, pull directly up, and the cord will unwind, rolling the spool from you, when the upward pull lifts the spool so that the friction on the table is equal or less than the upward pull of the string. Now move the hand over so that the string makes an angle less than a right angle with the table, and an angle may be found between the horizontal and the vertical at which the pull of the string makes the spool slide along the table without rolling at all. This angle will vary with the weight of the spool and the smoothness of the table top; that is, with the ratio of friction to weight. Other forms may be used in the experiment. Put a round rod through the hole in the spool, and lay two strips of board on edge so that the spool may roll on this rod as an axle. Now a pull on the string in any direction, with the string leaving the spool on the under side of the drum, will cause the spool to roll from you. Next take a cylinder, such as a short piece of curtain bar, fasten a cord to this and wind it over the bar so that it shall leave the bar at the middle of its length, and you will find that the bar will be simply dragged along without rolling at all. In the case of the ordinary spool the action is that of a lever of the third class. The weight is the spool acting at the center line through the spool, the power is in the string acting on the drum, and the fulcrum is on the rim of the spool on the table. The power is between the fulcrum and the weight. In the case of the cylinder the power and weight arms are equal, and the cylinder slides when the pull becomes equal to the frictional resistance. There is no tendency to roll.

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